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2020

NOTICE INVITING TENDER

(Document No PS:MSX:NIT)

TENDER NO.: BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250

NAME OF WORK: ALL CIVIL WORKS OF CW PIPES/CW DUCT
AT 2 X 660 MW KHURJA STPP AT KHURJA, UTTAR PRADESH.

Bharat Heavy Electricals Limited



NOTICE INVITING E-TENDER (NIT)

NOTE: BIDDER MAY DOWNLOAD FROM WEB SITES

To

Dear Sir/Madam

Sub : NOTICE INVITING E-TENDER

Sealed offers in two part bid system (National competitive bidding (NCB) are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-1) for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

SL NO	ISSUE	DESCRIPTION
i	TENDER NUMBER	BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250
ii	BROAD SCOPE OF JOB	ALL CIVIL WORKS OF CW PIPES/CW DUCT AT 2 X 660 MW KHURJA STPP AT KHURJA, UTTAR PRADESH.
iii	DETAILS OF TENDER DOCUMENT	
a	Volume-IA	<i>Technical</i> Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc
b	Volume-IB	Special Conditions of Contract (SCC)
c	Volume-IC	General Conditions of Contract (GCC)
d	Volume-ID	Forms and Procedures
e	Volume-II	Price Schedule (Absolute value).
iv	ISSUE OF TENDER DOCUMENTS	Tender documents will be available for downloading from BHEL eProcurement portal (https://eprocurebhel.co.in) till due date of submission: Brief information of the tenders shall also be available at BHEL website (www.bhel.com)
v	DUE DATE & TIME OF OFFER SUBMISSION	Date : 14/01/2022 , Time : 10:00 hrs Place : on https://eprocurebhel.co.in
vi	OPENING OF TENDER	Date : 14/01/2022, Time : 15:30 hrs Notes: (1) In case the due date of opening of tender becomes a non-working day, then the due date & time of offer submission and opening of tenders get extended to the next working day. (2) Bidder may depute representative to witness the opening of tender. For e-Tender, Bidder may

		witness the opening of tender through e-Procurement portal only.	
vii	EMD AMOUNT	Rs. 30,56,000/-	Applicable
viii	COST OF TENDER	Free	
ix	LAST DATE FOR SEEKING CLARIFICATION	Five days before bid submission due date. Along with soft version also, addressing to undersigned & to others as per contact address given below; 1) Name: G.V. RAJA SEKHAR Designation: Sr. MANAGER Deptt: SCT Address: BHEL-PSNR, PLOT NO. 25, SECTOR – 16A, NOIDA - 201301 Phone: (Landline) 0120-2416232 Email : gvr@bhel.in 2) Name: DESHRAJ YADAV Designation: Sr. ENGINEER Deptt: SCT Address: BHEL-PSNR, PLOT NO. 25, SECTOR – 16A, NOIDA - 201301 Phone: (Landline) 0120 - 2416261 Email : deshraj@bhel.in	Applicable
x	SCHEDULE OF PRE BID DISCUSSION (PBD)		Not Applicable.
xi	INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)	Please refer clause no. 15.	Applicable
xii	LATEST UPDATES	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc. to Tender Specifications will be hosted in BHEL webpage (www.bhel.com -->Tender Notifications →View Corrigendums), BHEL eProcurement portal (https://eprocurebhel.co.in) and not in the newspapers. Bidders to keep themselves updated with all such information.	

- 2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly signed digitally using Class III DSC & uploaded in E-Procurement Portal, as part of offer. **Rates/Price including discounts/rebates, if any, mentioned anywhere/in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.**
- 3.0 **Not Used.**
- 4.0 Unless specifically stated otherwise, bidder shall deposit EMD as per clause 1.9 of General Conditions of Contract.

For Electronic Fund Transfer the details are as below:-

a) Name of the Beneficiary :- Bharat Heavy Electricals Limited

b) Bank Particulars

i).	Bank Name :-	STATE BANK OF INDIA
ii).	Bank Telephone No.(with STD code):-	011-23475566
iii).	Branch Address:-	CAG II BRANCH, NEW DELHI 4 th & 5 th FLOOR, REDFORT CAPITAL, PARASNATH TOWERS, BHAI VEER SINGH MARG, GOLE MARKET, NEW DELHI-110001
iv).	Bank Fax No. (with STD code) :-	011-23475566
v).	Branch Code :-	17313
vi).	9 Digit MICR Code of the Bank Branch :-	110002562
vii).	Bank Account Number :-	10813608647
viii).	Bank Account Type :-	CASH CREDIT
ix).	11 Digit IFSC Code of Beneficiary Branch:-	SBIN0017313

(Note :- In case of E-Tenders, proof of remittance of EMD should be uploaded in the E-Procurement Portal and originals, as applicable, shall be sent to the officer inviting tender within a reasonable time, failing which the offer is liable to be rejected.)

5.0 **Procedure for Submission of Tenders**: This is an E-tender floated online through our E-Procurement Site (<https://eprocurebhel.co.in>). The bidder should respond by submitting their offer online only in our e-Procurement platform at (<https://eprocurebhel.co.in>). Offers are invited in two-parts only.

Documents Comprising the e-Tender

The tender shall be submitted online ONLY EXCEPT EMD (in physical form) as mentioned below:

a. Technical Tender (UN priced Tender)

All Technical details (e.g. Eligibility Criteria requested (as mentioned below)) should be attached in e-tendering module, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format):

- i. Earnest Money Deposit (EMD) furnished in accordance with NIT Clause 4.0. Alternatively, documentary evidence for claiming exemption as per clause 29 of NIT.
- ii. Technical Bid (without indicating any prices).

b. Price Bid:

- i. Prices are to be quoted in the attached Price Bid format online on e-tender portal.
- ii. The price should be quoted for the accounting unit indicated in the e-tender document.
- iii. Note: It is the responsibility of tenderer to go through the Tender document to ensure furnishing all required documents in addition to above, if any. Any deviation would result in REJECTION of tender and would not be considered at a later stage at any cost by BHEL.
- iv. A person signing (manually or digitally) the tender form or any documents forming part of the contract on behalf of another shall be deemed to warrantee that he has authority to bind such other persons and if, on enquiry, it appears that the persons so signing had no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.
- v. A tender, which does not fulfil any of the above requirements and/or gives evasive information/reply against any such requirement, shall be liable to be ignored and rejected.

DO NOT'S

Bidders are requested NOT to submit the hard copy of the Bid. In case offer is sent through hard copy/fax/telex/cable/electronically in place of e-tender, the same shall not be considered. **Also, uploading of the price bid in prequalification bid or technical bid may RESULT IN REJECTION of the tender.**

Digital Signing of e-Tender

Tenders shall be uploaded with all relevant PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION digital signature certificate (DSC).

The Requirement:

1. A PC with Internet connectivity &
2. DSC (Digital Signature Certificate) (**Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION**)

The contact details of the service provider are given below:

For any technical related queries please call at 24 x 7 Help Desk Number

0120-4001 002, 0120-4001 005 & 0120-6277 787

International bidders are requested to prefix 91 as country code

Email Support - Technical - support-eproc@nic.in

Note: For any Issues or Clarifications relating to the published tenders, bidders are requested to contact the respective Tender Inviting Authority

The process of utilizing e-procurement necessitates usage of **DSC (Digital Signature Certificate) (Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION)** and you are requested to procure the same immediately, if not presently available with you. Please note that only with DSC, you will be able to login the e-procurement secured site and take part in the tendering process.

The contact details of the DSC Certifying Authority as given below:

Sl. No.	Name	Website Link
1	GNFC	www.ncodesolutions.com
2	e-Mudhra	http://www.e-Mudhra.com
3	Safescrypt	www.safescrypt.com

Vendors are also requested to go through seller manual available on <https://eprocurebhel.co.in>.

- 6.0 Not used.
- 7.0 Deviation with respect to tender clauses and additional clauses/suggestions in Techno-commercial bid / Price bid shall NOT be considered by BHEL. Bidders are requested to positively comply with the same.
- 8.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD).

9.0 Assessment of Capacity of Bidders:

Bidder's capacity for executing the job under tender shall be assessed 'LOAD' wise and 'PERFORMANCE' wise as per the following:

- I. **LOAD:** Load takes into consideration **ALL** the contracts of the Bidder under execution with BHEL Regions, irrespective of whether they are similar to the tendered scope or not. The cut off month for reckoning 'Load' shall be the 3rd Month preceding the month corresponding to the 'latest date of bid submission', in the following manner -

(Note: For example, if latest bid submission is in Jan 2017, then the 'load' shall be calculated up to and inclusive of Oct 2016)

Total number of Packages in hand = Load (P)

Where 'P' is the sum of all unit wise identified packages (refer table-1) under execution with BHEL Regions as on the cut off month defined above, including packages yet to be commenced, excepting packages which are on Long Hold.

- II. **PERFORMANCE:** Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all Power Sector Regions of BHEL) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced shall be taken into consideration. The 'Period of Assessment' shall be 6 months preceding and including the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the 3rd Month preceding the month corresponding to 'latest date of bid submission', in the following manner:

(Note: For example, if 'latest date of bid submission' is in Jan 2017, then the 'performance' shall be assessed for a 6 months' period up to and inclusive of Oct 2016 (i.e. from May 2016 to Oct 2016), for all the unit wise identified packages (refer Table I))

- i). Calculation of Overall 'Performance Rating' for 'Similar Package/Packages' for the tendered scope under execution at Power Sector Regions for the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for all the similar Package/packages', divided by the total number of Package months for which evaluation should have been done, as per procedure below:

- $P_1, P_2, P_3, P_4, P_5, \dots, P_N$ etc. be the packages (under execution/ executed during the 'Period of Assessment' in all Regions of BHEL) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = P_T (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \dots + P_N$)
- Number of Months ' T_1 ' for which 'Monthly Performance Evaluation' as per relevant formats, should have been done in the 'Period of Assessment' for the corresponding similar package P_1 . Similarly T_2 for package P_2 , T_3 for package P_3 , etc. for the tendered scope. Now calculate cumulative total months ' T_T ' for total similar Packages ' P_T ' for all Regions (i.e. $T_T = T_1 + T_2 + T_3 + T_4 + \dots + T_N$)
- Sum ' S_1 ' of 'Monthly Performance Evaluation' Scores ($S_{1-1}, S_{1-2}, S_{1-3}, S_{1-4}, S_{1-5}, \dots, S_{1-T_1}$) for similar package P_1 , for the 'period of assessment' ' T_1 ' (i.e. $S_1 = S_{1-1} + S_{1-2} + S_{1-3} + S_{1-4} + S_{1-5} + \dots + S_{1-T_1}$). Similarly, S_2 for package P_2 for period T_2 , S_3 for package P_3 for period T_3 etc. for the tendered scope for all Regions. Now calculate cumulative sum ' S_T ' of 'Monthly Performance Evaluation' Scores for total similar Packages ' P_T ' for all Regions (i.e. ' $S_T = S_1 + S_2 + S_3 + S_4 + S_5 + \dots + S_N$ ')
- Overall Performance Rating ' R_{BHEL} ' for the Similar Package/Packages** (under execution/ executed during the 'Period of Assessment') in all the Power Sector Regions of BHEL

$$= \frac{\text{Aggregate of Performance scores for all similar packages in all the Regions}}{\text{Aggregate of months for each of the similar packages for which performance should have been evaluated in all the Regions}}$$

$$= \frac{S_T}{T_T}$$

- e) Bidders to note that the risk of non-evaluation or non-availability of the 'Monthly Performance Evaluation' reports as per relevant formats is to be borne by the Bidder.

- f) Table showing methodology for calculating 'a', 'b' and 'c' above

Sl. No.	Item Description	Details for all Regions							Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
1	Similar Packages for all Regions → (under execution/ executed during period of assessment)	P ₁	P ₂	P ₃	P ₄	P ₅	...	P _N	Total No. of similar packages for all Regions = P _T i.e. Sum (Σ) of columns (iii) to (ix)
2	Number of Months for which 'Monthly Performance Evaluation' as per relevant formats should have been done in the 'period of assessment' for corresponding Similar Packages (as in row 1)	T ₁	T ₂	T ₃	T ₄	T ₅	...	T _N	Sum (Σ) of columns (iii) to (ix) = T _T
3	Monthly performance scores for the corresponding period (as in Row 2)	S ₁₋₁ , S ₁₋₂ , S ₁₋₃ , S ₁₋₄ , ... S _{1-T1}	S ₂₋₁ , S ₂₋₂ , S ₂₋₃ , S ₂₋₄ , ... S _{2-T2}	S ₃₋₁ , S ₃₋₂ , S ₃₋₃ , S ₃₋₄ , ... S _{3-T3}	S ₄₋₁ , S ₄₋₂ , S ₄₋₃ , S ₄₋₄ , ... S _{4-T4}	S ₅₋₁ , S ₅₋₂ , S ₅₋₃ , S ₅₋₄ , ... S _{5-T5}		S _{N-1} , S _{N-2} , S _{N-3} , S _{N-4} , ... S _{N-TN}	-----
4	Sum of Monthly Performance scores of the corresponding Package for the corresponding period (as in row-3)	S ₁	S ₂	S ₃	S ₄	S ₅	...	S _N	Sum (Σ) of columns (iii) to (ix) = S _T

- ii). Calculation of Overall 'Performance Rating' (R_{BHEL}) in case at least 6 evaluation scores for 'similar Package/Packages' for the tendered scope ARE NOT AVAILABLE, during the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for ALL the packages, divided by the total number of Package months for which evaluation should have been done. 'R_{BHEL}' shall be calculated subject to availability of 'performance scores' for at least 6 'package months' in the order of precedence below:

- 'Period of Assessment' i.e. 6 months preceding and including the cut-off month
- 12 months preceding and including the cut-off month
- 24 months preceding and including the cut-off month

In case, R_{BHEL} cannot be calculated as above, then Bidder shall be treated as 'NEW VENDOR'. Further eligibility and qualification of this bidder shall be as per definition of 'NEW VENDOR' described in 'Explanatory Notes'.

- iii). Factor "L" assigned based on Overall Performance Rating (R_{BHEL}) at Power Sector Regions:

Sl. no.	Overall Performance Rating (R _{BHEL})	Corresponding value of 'L'
1	=60	NA

2	> 60 and ≤ 65	0.4
3	> 65 and ≤ 70	0.35
4	> 70 and ≤ 75	0.25
5	> 75 and < 80	0.2
6	≥ 80	NA

III. **'Assessment of Capacity of Bidder':**

'Assessment of Capacity of Bidder' is based on the Maximum number of packages for which a vendor is eligible, considering the performance scores of similar packages, as below:

Max number of packages $P_{Max} = (R_{BHEL} - 60) \text{ divided by corresponding value of 'L', i.e. } (R_{BHEL} - 60)/L$

Note:

- In case the value of P_{Max} results in a fraction, the value of P_{Max} is to be rounded off to next whole number
- For $R_{BHEL} = 60$, $P_{Max} = '1'$
- For $R_{BHEL} \geq 80$, there will be no upper limit on P_{Max}

The Bidder shall be considered 'Qualified' as per 'Assessment of Capacity of Bidder' for the subject Tender if $P \leq P_{Max}$
(Where P is calculated as per clause 'I' above)

IV. **Explanatory note:**

- Similar package means Boiler or ESP or Piping or Turbine or Civil or Structure or Electrical or C&I etc. at the individual level irrespective of rating of Plant and irrespective of whether the subject tender is a single package or as part of combined/composite packages. Normally Boiler, ESP, Piping, Turbine, Electrical, C&I, Civil, Structure etc. is considered individual level of package. For example, in case the tendered scope is a Boiler Vertical Package comprising of Boiler, ESP and Power Cycle Piping (i.e. the 'identified packages as per Table-1 below), the 'PERFORMANCE' part against sl.no. II above, needs to be evaluated considering all the identified packages (i.e. Boiler, ESP and Power Cycle Piping) and finally the Bidder's capacity to execute the tendered scope is assessed in line with III above.

- Identified Packages (Unit wise)

Table-1

Civil	Electrical and C&I	Mechanical
i). Enabling works ii). Pile and Pile Caps iii). Civil Works including foundations iv). Structural Steel Fabrication & Erection v). Chimney vi). Cooling Tower vii). Others (Civil)	i). Electrical ii). C&I iii). Others (Elect. and C&I)	i). Boiler & Aux (All types including CW Piping if applicable) ii). Power Cycle Piping/Critical Piping iii). ESP iv). LP Piping v). Steam Turbine Generator set & Aux vi). Gas Turbine Generator set & Aux vii). Hydro Turbine Generator set & Aux viii). Turbo Blower (including Steam Turbine) ix). Material Management x). FGD xi). ACC xii). Others (Mechanical)

- Bidders who have not been evaluated for at least six package months in the last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions, shall be considered "NEW VENDOR".

A 'NEW VENDOR' shall be considered qualified subject to satisfying all other tender conditions.

A 'NEW VENDOR' if awarded a job (of package/packages identified under this clause) shall be tagged as "FIRST TIMER" on the date of first LOI from BHEL.

The "FIRST TIMER" tag shall remain till completion of all the contracts against which vendor has been tagged as First Timer or availability of 6 evaluation scores within last 24 months preceding and including the Cut-off month in the online BHEL system for contractor performance evaluation in BHEL PS Regions.

A Bidder shall not be eligible for the next job as long as the Bidder is tagged as "FIRST TIMER" excepting for the Tenders which have been opened on or before the date of the bidder being tagged as 'FIRST TIMER'.

After removal of 'FIRST TIMER' tag, the Bidder shall be considered 'QUALIFIED' for the future tenders subject to satisfying all other tender conditions including 'Assessment of Capacity of Bidders'.

- iv). Consequent upon applying the criteria of 'Assessment of Capacity of Bidders' detailed above on all the bidders qualified against Technical and Financial Qualification criteria, if the number of qualified bidders reduces to less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then for further processing of the Tender, BHEL at its discretion reserves the right to also consider the bidders who are "not qualified" as per criteria of 'Assessment of Capacity of Bidders' and for this, procedure described in following three options shall be followed:
- All the bidders having Overall Performance Rating ('R_{BHEL}') ≥ 60 shall be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
 - If even after using option "a", the number of qualified bidders remains less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then in addition to bidders considered as per option "a", "First timer" bidders having average of available performance scores ≥ 60 upto and including the Cut Off month shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.
 - If even after using option "a" and "b", the number of qualified bidders remains less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then in addition to bidders considered as per option "a" and "b", "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall also be considered qualified against criteria of 'Assessment of Capacity of Bidders'.

Note:- In case, the number of bidders qualified against Technical and Financial Qualification criteria itself is less than minimum no. of bidders required for conducting RA as per extant RA Guidelines, then all bidders (a)- having Overall Performance Rating ('R_{BHEL}') ≥ 60 , (b)- "First timer" bidders having average of available performance scores ≥ 60 upto and including the Cut Off month, (c)- "First timer" bidders for whom no performance score is available in the system upto and including the Cut Off month, shall be considered qualified against criteria of 'Assessment of Capacity of Bidders' for further processing of tender.

- v). 'Under execution' shall mean works in progress as per the following:
- Up to execution of 90% of anticipated Contract Value in case of Civil, MM, Structural and Turbo Blower Packages
 - Up to Steam Blowing in case of Boiler/ESP/Piping Packages
 - Up to Synchronization in all Balance Packages

Note: BHEL at its discretion can extend (or reduce in exceptional cases in line with Contract conditions) the period defined against (a), (b) and (c) above, depending upon the balance scope of work to be completed.

- vi). Contractor shall provide the latest contact details i.e. mail-ID and Correspondence Address to SCT Department, so that same can be entered in the Contractor Performance Evaluation System, and in case of any change/discrepancy same shall be informed immediately. Login Details for viewing scores in Contractor Performance Evaluation System shall be provided to the Contractor by SCT Department.

- vii). Performance Evaluation for Activity Month shall be completed in Evaluation Month (i.e. month next to Activity Month) or in rare cases in Post Evaluation Month (i.e. month next to Evaluation Month) after approval from Competent Authority. In case scores are not acceptable, Contractor can submit Review Request to GM Site/ GM Project latest by 27th of Evaluation Month or 5 days after approval of score, whichever is later. However, acceptance/rejection of 'Review Request' solely depends on the discretion of GM Site/GM Project. After acceptance of Review Request, evaluation score shall be reviewed at site and the score after completion of review process shall be acceptable and binding on the contractor.
- viii). Project on Hold due to reasons not attributable to bidder -
- a. **Short hold:** Evaluation shall not be applicable for this period, however Loading will be considered.
 - b. **Long hold:** Short hold for continuous six months and beyond or hold on account of Force Majeure shall be considered as Long Hold. Evaluation as well as Loading shall not be considered for this period.
- ix). Performance evaluation as specified above in this clause is applicable to Prime bidder and Consortium partner (or Technical tie up partner) for their respective scope of work.
- 10.0 Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation, applicable wage structure, wage rules, etc. before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions.
- 11.0 For any clarification on the tender document, the bidder may seek the same in writing or through e-mail and/or through e-procurement portal, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.
- 12.0 BHEL may decide holding of pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.
- 13.0 In the event of any conflict between requirement of any clause of this specification/ documents/drawings/data sheets etc. or requirements of different codes/standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages/ other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting/submission of offer, else BHEL's interpretation shall prevail.
- 14.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender including PBD.
- 15.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), **if applicable**, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. **The names and other details of Independent External Monitor (IEM) for the subject tender is as given at Clause no. 1, Salient Features of NIT, Sl. no. (xi) above.**

"Integrity Pact (IP)"

- (a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

Sl. No.	IEM	Email
1.	Shri Arun Chandra Verma, IPS (Retd.)	acverma1@gmail.com
2.	Shri Virendra Bahadur Singh, IPS (Retd.)	vbsinghips@gmail.com

(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/ three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

(c) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only.

Note:

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are as per Clause no. 1, Salient Features of NIT, Sl. No. (ix) above.

- 16.0 The Bidder has to satisfy the Pre-Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of satisfying the Pre-Qualification Criteria specified in this NIT as per Annexure-I (as applicable), past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right not to consider offers of parties under HOLD.
- 17.0 In case BHEL decides on a 'Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorized representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful/Disqualified bidders under intimation to the respective bidders.
- 18.0 Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) unless specified otherwise.
- 19.0 BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com on "**supplier registration page**") for this tender. RA shall be conducted among all the techno-commercially qualified bidders. Price Bids of all the techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.
- 20.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.
- 21.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.
- 22.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.
- 23.0 Consortium Bidding (or Technical Tie up): Not Applicable
- 24.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements' duly self-certified and stamped by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

- 25.0 The bidder may have to produce original document for verification if so decided by BHEL.
- 26.0 The consultant / firm (and any of its affiliates) shall not be eligible to participate in tender(s) for the related works or services for the same project, if they were engaged for the consultancy services.
- 27.0 Guidelines/rules in respect of Suspension of Business dealings, Vendor evaluation format, Quality, Safety & HSE guidelines, Experience Certificate, etc. may undergo change from time to time and the latest one shall be followed. The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' is available on www.bhel.com on "**supplier registration page**".
- 28.0 The offers of the bidders who are on the banned/ hold list and also the offer of the bidders, who engage the services of the banned/ hold firms, shall be rejected. The list of **banned/ hold firms** is available on BHEL web site www.bhel.com.
- 28.1 Integrity commitment, performance of the contract and punitive action thereof:
- 28.1.1 **Commitment by BHEL:**
BHEL commits to take all measures necessary to prevent corruption in connection with the tender Process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.
- 28.1.2 **Commitment by Bidder/ Supplier/ Contractor:**
- (i) The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.
 - (ii) The bidder/ supplier/ contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.
 - (iii) The bidder/ supplier/ contractor will perform/ execute the contract as per the contract terms & conditions and will not default without any reasonable cause, which causes loss of business/ money/ reputation, to BHEL.

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage indulges in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the prices or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extant guidelines of the company available on www.bhel.com and / or under applicable legal provisions.

- 29.0 Not Applicable
- 30.0 The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website <http://www.bhel.com> and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.
- 31.0 **PREFERENCE TO MAKE IN INDIA:**

For this procurement, the local content to categorize a supplier as a Class I local supplier/ Class II local Supplier/Non-Local Supplier and purchase preferences to Class I local supplier, is as defined in Public Procurement (Preference to Make in India), Order 2017 dated 04.06.2020 issued by DPIIT. In case of subsequent

orders issued by the nodal ministry, changing the definition of local content for the items of the NIT, the same shall be applicable even if issued after issue of this NIT, but before opening of Part-II bids against this NIT.

31.1 Compliance to Restrictions under Rule 144 (xi) of GFR 2017

- I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. The Competent Authority for the purpose of this Clause shall be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT).
- II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.
- III. "Bidder from a country which shares a land border with India" for the purpose of this Clause means:-
 - a. An entity incorporated established or registered in such a country; or
 - b. A subsidiary of an entity incorporated established or registered in such a country; or
 - c. An entity substantially controlled through entities incorporated, established or registered in such a country; or
 - d. An entity whose *beneficial owner* is situated in such a country; or
 - e. An Indian (or other) agent of such an entity; or
 - f. A natural person who is a citizen of such a country; or
 - g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above.
- IV. The *beneficial owner* for the purpose of (III) above will be as under:
 1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.
Explanation
 - a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent of shares or capital or profits of the company.
 - b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.
 2. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership.
 3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person has ownership of or entitlement to more than fifteen percent of the property or capital or profits of the such association or body of individuals.
 4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
 5. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.
- V. An Agent is a person employed to do any act for another, or to represent another in dealings with third person.
- VI. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

Note:

- (i) The bidder shall provide undertaking for their compliance to this Clause, in the format provided in Annexure-11.
- (ii) Registration of the bidder with Competent Authority should be valid at the time of submission of bids and at the time of acceptance of the bids.

32.0 Not used

- 33.0 In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be decided by soliciting discounts from the respective L-1 bidders.

In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss/ draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).

Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

- 34.0 The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

35.0 Not used

36.0 Order of Precedence:

In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

- a. Amendments/Clarifications/Corrigenda/Errata etc. issued in respect of the tender documents by BHEL
- b. Notice Inviting Tender (NIT)
- c. Price Bid
- d. Technical Conditions of Contract (TCC)—Volume-1A
- e. Special Conditions of Contract (SCC) —Volume-1B
- f. General Conditions of Contract (GCC) —Volume-1C
- g. Forms and Procedures —Volume-1D

It may please be noted that guidelines/ circulars/ amendments/ govt. directives issued from time to time shall also be applicable.

for BHARAT HEAVY ELECTRICALS LTD
(SCT)

Enclosures:

- (i) Annexure-1: Pre Qualifying Requirements.
- (ii) Annexure-2: Check List.
- (iii) Annexure-3: Not Used
- (iv) Annexure-4: Reverse Auction Process Compliance Form
- (v) Annexure-5: Authorization of representative who will participate in the online Reverse Auction Process
- (vi) Annexure-6: RA Price Confirmation and Breakup
- (vii) Annexure-7: Integrity Pact
- (viii) Annexure-8: Undertaking as per C4 of Annexure-1 i.e. PQR
- (ix) Annexure-9: Declaration reg. Related Firms & their areas of Activities
- (x) Annexure-10: Declaration reg. minimum local content in line with revised public procurement
- (xi) Annexure-11: Declaration by the Contractor
- (xii) Other Tender documents as per this NIT.

ANNEXURE - 1**PRE QUALIFYING REQUIREMENTS**

JOB	ALL CIVIL WORKS OF CW PIPES/CW DUCT AT 2 X 660 MW KHURJA STPP AT KHURJA, UTTAR PRADESH.
TENDER NO	BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250

SL. NO.	NAME AND DESCRIPTION OF PRE-QUALIFICATION CRITERIA	BIDDER'S CLAIM IN RESPECT OF FULFILLING THE PQR CRITERIA
A	Submission of Integrity Pact duly signed	Applicable
B	<u>Technical</u>	Applicable
B-1	Bidder who wish to participate should have: Bidder should have executed similar works for any one of the following in the last seven (7) years from latest date of bid submission: One (01) work of value not less than Rs. 16.45 Crs. OR Two (02) works each of value not less than Rs. 10.28 Crs OR Three (03) works each of value not less than Rs. 8.22 Crs <u>Note:</u> 'Similar Works' means "Piling or Civil or Structural or 'Civil and Structural works' or RCC Chimney or RCC Cooling Tower or RCC Silo or Mill Bunker or Process Industry or any combination of these shall be considered."	
B-2	<u>Civil Works:</u> Executed: 1. At least 7770 CUM of concreting, within a common period of twelve consecutive months in cumulative of two running/ completed contracts. OR 2. At least 5180 CUM of concreting, within period of twelve consecutive months in one running/ completed contract. * Bidder should have executed above mentioned concreting works of encasement of pipes at any Power House/any Process industry or concreting of Power house building or any combination of these shall be considered.	Applicable
B-3	<u>Structural Works:</u> Executed: 1. Laying of Steel Pipes of diameter more than 1000 mm for at-least 500 m length at any power house/ process industry AND 2. Successful field joints of pipes and hydro test at any power house/process industry	Applicable

C	<u>FINANCIAL:</u>	Applicable
C-1	<u>TURNOVER:</u> Bidders must have achieved an average annual financial turnover (Audited) of Rs. 6.16 Crore or more over three consecutive Financial Years (FY) from immediate four previous Financial Years i.e. (2017-18, 2018-19 & 2019-20 OR 2018-19, 2019-20 & 2020-21). Bidder shall submit the Audited Balance Sheet and Profit & Loss Account in support of this. In case audited financial statements have not been submitted for all the three years as indicated above, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years. If financial statements are not required to be audited statutorily, then instead of audited financial statements, financial statements are required to be certified by Chartered Accountant.	
C-2	<u>NET WORTH:</u> Net worth (only in case of companies) of the bidder should be positive. <u>Note:</u> Net worth shall be calculated based on the latest Audited Accounts, as furnished for 'C-1' above. Net worth = Paid up share capital + Reserves.	Applicable
C-3	<u>PROFIT:</u> Bidder must have earned profit in any one of the three financial years as applicable in the last three financial years as furnished for 'C-1' above. <u>Note:</u> PROFIT shall be PBT earned during any one year of last three financial years as in 'C-1' above.	Applicable
C-4	Bidder must not be under Insolvency Resolution Process or Liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/authorities, which will render him ineligible for participation in this tender, and shall submit undertaking (Annexure-8) to this effect.	Applicable
D	Assessment of Capacity of bidder to execute the work as per clause 9.0 of NIT	Applicable – by BHEL
E	Approval of Customer <u>Note:</u> Names of bidders who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval.	Applicable – by BHEL
F	Price Bid Opening <u>Note:</u> Price Bids of only those bidders shall be opened who stand qualified after compliance of criteria A to E	By BHEL

Explanatory Notes for QR 'B':

1. For Sl. No 'B-1' above the word 'Similar Works' means "Piling or Civil or Structural or 'Civil and Structural works' or RCC Chimney or RCC Cooling Tower or RCC Silo or Mill Bunker or Process Industry or any combination of these shall be considered."
2. For evaluation of PQR, in case Bidder alone does not meet the pre-qualifying technical criteria B-1 above, bidder may utilize the experience of its Parent/Subsidiary Company along with its own experience, subject to following:
 - a. The parent Company shall have a controlling stake of $\geq 50\%$ in the subsidiary company (as per Format-1).
 - b. The parent company/subsidiary company of which experience is being utilized for bidding shall submit Security Deposit (SD) equivalent to 1% of the total contract value.

- c. The parent/Subsidiary Company and bidder shall provide an undertaking that they are jointly or severally responsible for successful performance of the contract (as per Format-2)
3. Completion date for achievement of the technical criteria specified in the QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work. Completion date shall be reckoned from the "FY quarter of bid submission".
4. For QR 'B', 'Executed' means the bidder should have achieved the technical criteria, specified in QR as above, even if the total contract has not been completed or closed.
5. For sl.no. 'B-1' above, actual executed value shall be considered. The evaluation currency for this tender shall be **INR**.

For sl.no. 'B-1' above, Value of work is to be updated with indices for "All India Avg. Consumer Price index for industrial workers" and "Monthly Whole Sale Price Index for All Commodities" with base month as per last month of work execution and indexed up to three (3) months prior to the month of latest due date of bid submission as per following formula-

$$P = \left\{ R + 0.425 \times R \times \frac{(X_N - X_0)}{X_0} + 0.425 \times R \times \frac{(Y_N - Y_0)}{Y_0} \right\}$$

Where

P = Updated value of work

R = Value of executed work

X_N = All India Avg. Consumer Price index for industrial workers for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).

X_0 = All India Avg. Consumer Price index for industrial workers for last month of work execution

Y_N = Monthly Whole Sale Price Index for All Commodities for three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 02-Mar-17, then bid submission month shall be reckoned as March'17 and index for Dec'2016 shall be considered).

Y_0 = Monthly Whole Sale Price Index for All Commodities for last month of work execution.

BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK ORDER AND WORK COMPLETION CERTIFICATE ETC IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

Credentials submitted by the bidder against "PRE QUALIFYING CRITERIAS" shall be verified for its authenticity. In case, any credential (s) is/are found unauthentic, offer of the bidder is liable to the rejection. BHEL reserves the right to initiate any further action as per extant guidelines for Suspension of Business Dealings.

Format-1**Certificate for relationship between Parent Company / Subsidiary Company and the bidder**

To,

.....

.....

Dear Sir,

Sub: Bid for NIT No dated..... for “.....” (name of the tender).

We hereby certify that M/s..... is Parent Company/ Subsidiary Company of M/s(the bidder) and details of equity holding of the Parent Company in Subsidiary Company as on(not earlier than seven days prior to the Bid Submission Date) are given as below:

Name of Parent Company	Name of Subsidiary Company	Percentage of Equity Holding of Parent Company in Subsidiary Company

(Insert Name and Signature of Statutory Auditor or practicing Company Secretary of the Bidder)

Undertaking from the Parent Company/ Subsidiary Company of the bidder
(On the Letter Head of Parent Company/ Subsidiary Company, as applicable)

From,
Name:
Full Address:

Telephone No.:
E-mail address:
Fax/No.:

To,
.....
.....

Dear Sir,

We refer to the NIT No dated..... for “.....” (name of the Tender).

“We have carefully read and examined in detail the NIT/Tender Terms and Conditions, including in particular, Clause of the NIT/Tender, regarding submission of an Undertaking, as per the prescribed Format 1 of the NIT/ Tender.

We confirm that M/s..... (the Bidder) has been authorized by us to use our Technical capability for meeting the Technical Criteria as specified in Clause.....of the PQR of the NIT/Tender referred above.

We agree to submit the Security Deposit equivalent to 1% of the total contract value in addition to Security Deposit to be submitted by Bidder as per Clause.....of the NIT/Tender for fulfilment of all obligations in terms of provisions of the contract, in the event of(the Bidder) being selected as the Successful Bidder.

We confirm that we along with M/s.....(the bidder), are jointly or severally responsible for successful performance of the contract.

We confirm that our company shall not participate in the above tender as a ‘Standalone Bidder’ or as a ‘Consortium bidder’ and also shall not authorize any other bidder to use our Technical capability for the above tender.

All the terms used herein but not defined, shall have the meaning as ascribed to the said terms under the referred NIT/Tender.

Signature of Managing Director/Authorized signatory of Parent/ Subsidiary Company

ANNEXURE - 2**CHECK LIST****NOTE: - Tenderers are required to fill in the following details and no column should be left blank**

1	Name of the Tenderer		
2	Address of the Tenderer		
3	Type of the Firm/ Company		
(i)	In case of Individual Tenderer	His / her full name, address and place & nature of business shall be furnished along with the offer.	
(ii)	In case of Partnership Firm	The names of all the partners and their addresses, A copy of the partnership deed/instrument of partnership duly certified by the Notary Public shall be furnished along with the offer..	
(iii)	In case of Companies	a) Date and place of registration including date of commencement certificate in case of Public Companies (certified copies of Memorandum and articles of Association are also to be furnished). b) Nature of business carried on by the Company and the provisions of the Memorandum relating thereof.	
4.a	Details of Contact person for this Tender	Name : Mr/ Ms Designation: Telephone No: Mobile No: Email ID:	
4.b	Details of alternate Contact person for this Tender	Name : Mr/ Ms Designation: Telephone No: Mobile No: Email ID:	
5	EMD DETAILS		
6	Validity of Offer	TO BE VALID FOR SIX MONTHS FROM DUE DATE	
	DESCRIPTION	APPLICABILITY (BY BHEL)	ENCLOSED BY BIDDER
7	Whether all pages of the Tender documents including annexures, appendices etc are read and understood	Applicable	YES / NO
8	Whether the format for compliance with PRE QUALIFICATION CRITERIA (ANNEXURE – 1) is understood and filled with proper supporting documents referenced in the specified format	Applicable	YES / NO
9	Audited Balance Sheet and profit & Loss Account for the last three years	Applicable	YES / NO
10	Copy of PAN Card	Applicable	YES / NO
11	Copy of GST registration	Applicable	YES / NO

SL. NO.	DESCRIPTION	APPLICABILITY (BY BHEL)	ENCLOSED BY BIDDER
12	Organization Chart of the tenderer's organization, including the names, addresses and contact information of the Directors/Partners shall be furnished along with the offer.	Applicable	YES / NO
13	Integrity Pact (Annexure – 7 of NIT)	Applicable	YES / NO
14	Annexures – 5, 8, 9, 10 & 11 of NIT	Applicable	YES / NO
15	Offer forwarding letter / tender submission letter [Form No. F-01 (Rev 00)]	Applicable	YES / NO
16	Declaration by Authorised Signatory [Form No: F-02 (Rev 00)]	Applicable	YES / NO
17	Declaration by Authorised Signatory regarding Authenticity of submitted documents [Form No: F-02A (Rev 00)]	Applicable	YES / NO
18	No Deviation Certificate [Form No: F-03 (Rev 00)]	Applicable	YES / NO
19	Declaration confirming knowledge about Site Conditions [Form No: F-04 (Rev 00)]	Applicable	YES / NO
20	Declaration for relation in BHEL [Form No: F-05 (Rev 00)]	Applicable	YES / NO
21	Non-Disclosure Certificate [Form No: F-06 (Rev 00)]	Applicable	YES / NO
22	Bank Account Details for E-Payment [Form No: F-07 (Rev 00)]	Applicable	YES / NO
23	Format for seeking clarification [Form No: F-08 (Rev 00)]	Applicable	YES / NO
24	Capacity Evaluation of Bidder for current Tender [Form No: F-09 (Rev 00)]	Applicable	YES / NO
25	Power of Attorney for Submission of Tender/Signing Contract Agreement [Form No: F-25 (Rev 00)]	Applicable	YES / NO
26	Analysis of Unit rates [Form No: F-26 (Rev 00)]	Applicable	YES / NO

NOTE: STRIKE OFF 'YES' OR 'NO', AS APPLICABLE. TENDER NOT ACCOMPANIED BY THE PRESCRIBED **ABOVE APPLICABLE DOCUMENTS** ARE LIABLE TO BE SUMMARILY REJECTED.

DATE :

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

ANNEXURE – 3

NOT USED

ANNEXURE - 4**Reverse Auction Process Compliance Form**

(The bidders are required to print this on their company's letterhead and sign, stamp before RA)

To

- M/s. {Service provider}
- Postal address}

Sub: Agreement to the Process related Terms and Conditions

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no.{.....} dt. {.....}

This letter is to confirm that:

- 1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
- 2) We have studied the Reverse Auction guidelines (as available on www.bhel.com), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
- 3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
- 4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per Annexure - 6 within **two** working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {Service provider.}

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal

Name:

Company / Organization:

Designation within Company / Organization:

Address of Company / Organization:

Sign this document and FAX/ email it to M/s {Service provider} at {.....} prior to start of the Event.

ANNEXURE – 5**Authorization of representative who will participate in the on line Reverse Auction Process:**

1	NAME OF THE BIDDER	
2	NAME & DESIGNATION OF OFFICIAL	
3	POSTAL ADDRESS (COMPLETE)	
4	TELEPHONE NOS. (LAND LINE & MOBILE BOTH)	
5	E-MAIL ADDRESS	
6	NAME OF PLACE/ STATE/ COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	

ANNEXURE – 6

RA price confirmation and breakup
(To be submitted by L1 bidder after completion of RA)

To

- M/s. Service provider
- Postal address

CC: M/s BHEL

{Unit-
Address-}

Sub: **Final price quoted during Reverse Auction and price breakup**

Dear Sir,

We confirm that we have quoted.

Rs.{____ in value & in words _____} for item(s) covered under tender enquiry No. {...} dt.{...}

Total price of the items covered under above cited enquiries is inclusive of {Packing & forwarding, GST, E.D., C.S.T., freight and insurance charges up to {.....} District,{.....} State and Type Test Charges etc., (exclusive of service tax), other as per NIT}

as our final landed prices as quoted during the Reverse Auction conducted today {date} which will be valid for a period of {____ in nos. & in words ____} days.

The price break-up is as given below.

Total

=====

- Rs. in value & in words

=====

Yours sincerely,

For _____

Name:**Company:****Date:****Seal:**

ANNEXURE – 7

INTEGRITY PACT

Integrity Pact format attached separately

ANNEXURE – 8

UNDERTAKING

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir/Madam,

Sub: DECLARATION REGARDING INSOLVENCY/ LIQUIDATION/ BANKRUPTCY PROCEEDINGS

Ref: NIT/Tender Specification No: BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250

I/We, _____

declare that, I/We am/are not under insolvency resolution process or liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/authorities, which will render us ineligible for participation in this tender.

**Sign. of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)**

Place:

Date:

ANNEXURE-9**DECLARATION**

Date: _____

To: _____
Address: BHEL, _____

Email: _____

Sub: **Details of related firms and their area of activities**

Dear Sir/ Madam,

Please find below details of firms owned by our family members that are doing business/ registered for same item with BHEL, _____ (NA, if not applicable)

1	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
2	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
...		

Note: I certify that the above information is true and I agree for penal action from BHEL in case any of the above information furnished is found to be false.

Regards,

(_____)

From: M/s _____
Supplier Code: _____
Address: _____

Annexure-10**DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH
REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH
JUNE, 2020 AND SUBSEQUENT ORDER(S)***(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)*

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent order(s).**Ref :** 1) NIT/Tender Specification No: **BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250**
2) All other pertinent issues till date

We hereby certify that the items/works/services offered by..... (specify the name of the organization here) has a local content of _____ % and this meets the local content requirement for '**Class-I local supplier**' / '**Class II local supplier**' ** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

1. _____	2. _____
3. _____	4. _____
...	
...	
...	

Thanking you,
Yours faithfully,**(Signature, Date & Seal of
Authorized Signatory of the Bidder)****** - Strike out whichever is not applicable.****Note:**

1. Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
2. In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practising cost accountant or practicing chartered accountant (in respect of suppliers other than companies).
3. In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder.

ANNEXURE-11

DECLARATION REGARDING COMPLIANCE TO RESTRICTIONS UNDER RULE 144 (xi) OF GFR 2017
(To be typed and submitted in the Letter Head of the Entity/ Firm providing certificate as applicable)

To,
(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration regarding compliance to Restrictions under Rule 144 (xi) of GFR 2017

Ref : 1) NIT/Tender Specification No: **BHEL/NR/SCT/KHURJA/CW DUCT/CIVIL/1250**
2) All other pertinent issues till date

I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries. I certify that _____ **(SPECIFY THE NAME OF THE ORGANIZATION HERE)**, is not from such a country/ has been registered with the Competent Authority (attach valid registration by the Competent Authority, i.e., the Registration Committee constituted by the Dept. for Promotion of Industry and Internal Trade (DPIIT); and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. (attach relevant valid registration, if applicable)

I hereby certify that we fulfil all requirements in this regard and is eligible to be considered.

Thanking you,
Yours faithfully,

**(Signature, Date & Seal of
Authorized Signatory of the Bidder)**

Note: Bidders to note that in case above certification given by a bidder, whose bid is accepted, is found to be false, then this would be a ground for immediate termination and for taking further action in accordance with law and as per BHEL guidelines.

INTEGRITY PACT**Between**

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

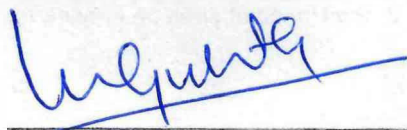
1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.



Section 2 - Commitments of the Bidder(s)/ Contractor(s)

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
- 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to

demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 - Equal treatment of all Bidders/ Contractors / Sub-contractors

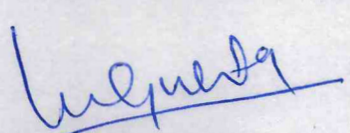
- 6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.
- 6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 - Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.



- 8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.
- 8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.
- 8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.
- 8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.
- 8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.
- 8.12 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration

- 9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.
- 9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

- 10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.



BHEL-IP

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

For & On behalf of the Principal

(Office Seal)

Place-----

Date-----

For & On behalf of the Bidder/

Contractor

(Office Seal)

Witness:_____

(Name & Address) _____

Witness:_____

(Name & Address) _____

V. K. Gupta

 **वी. के. गुप्ता / V. K. GUPTA**
अध्यक्ष महाप्रबंधक (उप संचिदा एवं क्रय)
Addl. General Manager (SCP)
भारत हेवी इलेक्ट्रिकल्स लिमिटेड, पावर सेक्टर-उत्तरी क्षेत्र
Bharat Heavy Electricals Ltd., Power Sector-Northern Region
प्लॉट सं.25, सेक्टर-16ए, नोएडा/Plot No.25, Sec.16A, Noida

TECHNICAL CONDITIONS OF CONTRACT (TCC)

NAME OF WORK: ALL CIVIL WORKS OF CW
PIPES/CW DUCT AT 2X660MW KHURJA STPP AT
KHURJA, UTTAR PRADESH

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

CONTENTS

Sl. No.	DESCRIPTION	Chapter	PAGENO.
Volume-IA	Part-I: Contract specific details		
1	Project Information	Chapter-I	3-4
2	Scope of Works	Chapter-II	5-9
3	Facilities in the scope of Contractor/BHEL (Scope Matrix)	Chapter-III	10-19
4	T&Ps and MMEs to be deployed by Contractor	Chapter-IV	20-25
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6	Time Schedule	Chapter-VI	28-39
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1	TECHNICAL SPECIFICATION		

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - I : Project Information

2X660MW KHURJA STPP- STG PACKAGE

INTRODUCTION

THDC, a joint venture of Government of India & Government of UP, has awarded the work to BHEL for supply, construction/erection for CW system civil works package for 2x660MW Khurja STPP at Khurja, U.P.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

S.No.	Title	Description
1	Owner	THDC India Limited
2	Consultant	NTPC Limited
3	Project Title	2X660MW KHURJA STPP – CW SYSTEM CIVIL WORKS PACKAGE
4	Project Site Location	Khurja STPP is located in Bulandshahar district of Uttar Pradesh. The site is situated near villages Dushhara-kherli, Jahanpur, Naiphal (Unchagaon) and Rukunpur. The district Headquarters Bulandshahar is about 32Kms. Distance of the project site from Delhi is about 90Kms.
5	Nearest Railway Station	The nearest railway station Danwar on Delhi-Kolkata section (via Aligarh) is approx. 5Km away from the project site. The nearest major railway station is Khurja at a distance of about 11kms.
6	Nearest Airport	The nearest commercial airport is Delhi at about 120 km by road
7	Nearest Highway	NH34
8	Nearest Water Body	The upper Ganga canal passes near by the Khurja STPP at a distance of about 13 Kms
9	Land	Land is in possession of THDC
10	Location Co ordinate	Project is located between 28°08'35" to 28°10'25" Northern latitude and 77°53'47" to 77°55'22" Eastern longitude.
11	Seismic Data	The area falls in Zone III (Moderate), according to the Indian Standard Seismic Zoning Map

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - I : Project Information

Note: - The bidder is advised to visit and examine the site of WORKS and its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the bid and entering into the Contract. All costs for and associated with site visits shall be borne by the bidder.

INSTRUCTIONS TO TENDERERS

The Tenderer are advised to physically visit the site and fully acquaint themselves with site conditions, transportation routes, various distances and the fact that other contractors would be working in this area and their structures are to be protected. The material brought and stacked for construction should not make hindrance to other contractors. **Necessary precaution and arrangements including sprinkling of water during work as acceptable to BHEL for safety & security for the above have to be made by the contractor. No claim will be entertained by BHEL on ground of lack of knowledge and the contractor's rates shall be deemed to have taken this into account.**

The contractor, in the event of this work awarded to him, shall establish an office at site and keep posted an authorized, responsible officer with valid Power of Attorney for the purpose of the contract. Any order or instructions of the 'Engineer' or his duly authorized representative, communicated to the contractor's representative at site office will be deemed to have been communicated to the contractor at his legal address.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - II: Scope of Works

2.0	GENERAL SCOPE OF WORK
2.1	Scope of this tender covers “ALL CIVIL WORKS OF CW PIPES/ CW DUCT AT 2 X 660 MW KHURJA” AT KHURJA, UTTAR PRADESH
2.2	The brief scope of work is as follows: 1. Complete civil work for laying MS pipes including excavation, backfilling, and encasement of CW pipes with PCC/RCC. 2. Complete civil and structural works associated with CW steel pipe from CW pump house to terminal point at Transformer yard and from terminal point at Transformer yard to the IDCTs. The pipes are to be concrete (RCC/PCC) encased below ground. 3. Painting of all steel structures and the pipes above the ground, corrosion protection measures of all the buried/ encased pipes. 4. Hydro testing of CW pipes 5. Handling of all free issued material. Handling shall include unloading of material from supplier's vehicle at store, loading and further transportation of material from store to erection site, unloading of material at erection site and further diversion of surplus/scrap generated at site till BHEL store. The above provided list is indicative only for the bidder's guideline. Any other work not mentioned above, but required for completion of the project in total, deemed to have been included in the bidder scope under this contract. Such work will be executed under this contract by bidder as per the direction of Engineer in charge.
2.2.1	➤ The contractor's scope shall include excavation in soil, dewatering, dressing to required profile, sheet piling or shoring/strutting, backfilling around completed structures, disposal of surplus earth and rock, concreting including reinforcement and formwork, RCC, Hydro test, Laying of pipes, encasement of pipe, complete work of handling, unloading of material from supplier's trailers, loading and transporting of materials from project stores sheds / storage yards to site of erection or preassembly yard and unloading at pre-assembly area/erection site, checking, cleaning chipping and levelling and site clearance before handing over to Owner including supply of all materials (except those specified in BHEL scope), consumables, labor, Tools and plants, transportation and storage, sample testing etc. all complete as per BOQ, technical specifications and drawings for proper and successful execution of the job for ALL CIVIL WORKS OF CW PIPES/ CW DUCT AT 2 X 660 MW KHURJA. ➤ The area of work shall be cleared of all vegetation, rubbish and other objectionable matter and materials including dismantling, removing and disposing off the existing underground structures / facilities etc. (if found), shall be burnt or otherwise disposed of as directed by the Engineer-in-Charge.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - II: Scope of Works

	No separate payment for these operations shall be made. The cost of all these operations shall be deemed to have been included in the unit rates rendered for the different items under bill of quantities. ➤ All the works areas shall be adequately flood lighted to the satisfaction of the Engineer-in-Charge when the work is in progress during the night shifts. ➤ The unit rates shall include all material equipment, fixtures, labor construction plant, temporary works and everything whether of permanent or temporary nature necessary for the completion of job in all respects. ➤ The unit rates quoted for various items of B.O.Q shall include all the stipulations mentioned in technical specifications under Part II and nothing extra over B.O.Q rates shall be payable. ➤ Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner as far as possible. ➤ The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications
2.2.2	<u>Cement and Steel Supply:</u> Cement, Reinforcement Steel and Structural Steel/Prefabricated CW Duct/Pipes (as per BOQ cum Rates Schedule) required for this tender's scope shall be procured by BHEL and issued to contractor as Free of Cost (FOC) Item. However unloading, handling / storage of Cement and Reinforcement/Structural steel/CW Duct procured by BHEL for this tender scope at site, inside BHEL Stores / Contractor's Stores/from supplier's trailers and further transportation till Store and then to work area will be in the scope of contractor. No Extra payment shall be made for this work. All sort of material handling for the purpose of this contract is in the scope of bidder without any additional cost to BHEL.
2.2.3	The working area shall be separated from the existing plant area (if required) by cordoning off the area by providing MS / GI sheets of suitable heights with appropriate frame work as approved by BHEL/ Customer. No extra payment shall be paid to contractor for this work.
2.2.4	The Customer THDC India Ltd. may depute their representative for checking and supervision of important stages of work. The contractor shall be required to provide all facilities for inspection of works at no extra cost to BHEL. Any defect in quality of work or deviations from drawings / specifications pointed out during such inspection shall be made good by the contractor in the same way as if pointed out by the BHEL Engineer, without any cost implication to BHEL.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - II: Scope of Works

2.2.5	The work under this contract shall be carried out as per BOQ Cum Rate Schedule. In case the description / specifications as per BOQ are found to be incomplete, Indian standard specifications shall be followed. Quantities mentioned in the BOQ cum Rate schedules are approximate only and liable for variation due to change in scope of work / variation in schedule of quantities, changes in design etc. The contractor shall undertake to execute actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out on the basis of quantities actually executed at site and payments will also be regulated for the same. The quantities indicated against each item may vary to any extent and no compensation will be payable in variation of Individual quantity.
2.2.6	The complete works shall be carried out as per BOQ cum Rate schedule. If any work covered in the scope of contract cannot be executed using items available in BOQ, additional / extra items shall be made and rates for such items shall be worked out as per GCC clause 2.15.7. However, contractor shall be bound to execute all the works under the scope of the contract and decision whether an extra item is applicable or not, shall be taken by BHEL Engineer which will be binding on the contractor.
2.2.7	Any activity which is necessarily required for satisfactory execution of any item of BOQ in line with technical specifications shall be deemed to be included in BOQ item even if it is not described in the item description and no extra payment shall be made against such activity.
2.3	<u>The technical requirements for work to be executed under this specification shall be as per Technical Specifications, enclosed with this tender document. (Part - II)</u>
2.4	Contractor's scope also includes following:
2.4.1	Furnishing all labor, materials (except those specified in BHEL scope), supervision, construction plans, equipment, material, scaffolding, tools and plants, transport to and from the site, materials handling, storage, fuel, electricity, compressed air, water and all other incidental items and temporary works not shown or specified but reasonably implied or necessary for the proper completion, maintenance and handing over the works, in accordance with the stipulations laid down in the contract documents and additional stipulations as may be provided by BHEL Engineer during the course of works.
2.4.2	Supervisors / Engineers, labours and other staff, consumables etc., required for the scope of work shall be provided by the contractor. It shall be specially noted that the contractor's labour and staff may have to work round the clock to meet the completion schedules / plans, which may involve payment of considerable overtime. The contractor's quoted rates should be inclusive of all such contingencies.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - II: Scope of Works

2.4.3	Furnishing samples of all materials required by the engineers for testing / inspection and approval for use in the works. The samples may be retained by the engineer for final incorporation in the works. Furnishing test reports for the products used or intended to be used, if called for the specifications or if so desired by the engineer.
2.4.4	Giving all notices, paying all fees, taxes etc., in accordance with the general conditions of contract, that are required for all works including temporary works. All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.
2.4.5	Arranging manufacturer's supervision for items of work done as per manufacturer's specifications when so specified.
2.4.6	The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.
2.4.7	The work covered under this specification is of highly sophisticated nature requiring the best quality of workmanship, engineering and construction management. The contractor should ensure timely completion of the work. The contractor must have the adequate quantity of tools, construction aids, equipments, etc., in this possession. He must also on his rolls adequate trained, qualified and experienced supervisory staff and skilled personnel.
2.4.8	The scope of work will also include such other related works although they may not be specifically mentioned in the above paragraph and all such incidental items not specified but reasonably implied and necessary for completion of the job as a whole all as desired and as directed by the engineer.
2.4.9	The scope of work covered above is not a comprehensive list of items of work involved. The detail scope of work may vary considerably depending on the actual construction requirements. It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
2.4.10	Mix design for all concreting shall be carried out from a reputed approved institute, contractor has to ensure adding of admixture and minimizing of cement content in line with IS 456 as advised by BHEL time to time without any additional cost. Bidder may use approved available Design Mix at site with approval of Engineer In charge. Engineer In charge decision shall be final and binding in this regard.
2.4.11	The bidder scope shall also include setting up a testing laboratory in the field to carry out all relevant tests. Laboratory equipment is to be arranged by the contractor within

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter - II: Scope of Works

	quoted rate for conducting required material testing at site. Necessary chemist is also to be deployed at laboratory. The bidder may tie up with approved/registered inspection agencies for setting up test lab at site as described above.
2.4.12	Where ever the Supply & Erection together is covered in the scope of bidder necessary approvals from BHEL / THDC shall be taken by bidder for the design, inspection procedure & its vendor. List of items for which such approvals required will be frozen during execution of the contract. No material is to be designed, procured or erected before the confirmation & prior approval by Engineer in charge. NOTE: 1. Contractor shall procure and supply the items to project site as per the BOQ from BHEL / THDC approved vendors, meeting the specification, Drawings and instructions of the Engineer.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.0	<u>ESTABLISHMENT</u>			
3.1	<u>FOR CONSTRUCTION PURPOSE:</u>			
3.1.1	Open space for office	Yes		BHEL may provide free of charge limited open space for office and store as and where made available by the customer i.e. THDC.
3.1.2	Open space for storage	Yes		
3.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
3.1.4	Bidder's all office equipment, office / store / canteen consumables		Yes	
3.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
3.1.6	Firefighting equipment like buckets, extinguishers etc.		Yes	
3.1.7	Fencing of storage area, office, canteen etc. of the bidder		Yes	
3.2	<u>FOR LIVING PURPOSES OF THE BIDDER</u>			
3.2.1	Open space		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.2.2	Living accommodation		Yes	Bidder has to make his own arrangement at his own cost
3.3	<u>ELECTRICITY</u>			
3.3.1	<u>Electricity For construction purposes (Chargeable)</u>	Yes		Construction Power will be provided at single point source on chargeable basis as and where made available by Owner, however contractor has to deploy DG Sets at no extra cost to BHEL to meet power requirement in case of delay in availability of single source or any kind of power interruptions during the course of the project.
3.3.1.1	Single Point source	Yes		
3.3.1.2	Further distribution for the work to be done which include supply of all materials, energy meter, protection devices and its execution& service		Yes	
3.3.1.3	Duties and deposits including statutory clearances if applicable		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.3.2	<u>Electricity for the office, stores, canteen etc. of the bidder, which include:</u>		Yes	
3.3.2.1	Distribution from single point including supply of materials and service		Yes	
3.3.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	
3.3.2.3	Duties and deposits including statutory clearances for the above		Yes	
3.3.2.4	Living facilities for office use including charges		Yes	
3.3.2.5	Demobilization of the facilities after completion of works		Yes	
3.3.3	<u>Electricity for living accommodation of the bidder's staff, engineers, supervisors etc. on the above lines.</u>		Yes	
3.4.0	<u>WATER SUPPLY</u>			
3.4.1	<u>For construction purposes:</u>			

TECHNICAL CONDITIONS OF CONTRACT (TCC)
Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.4.1.1	Making the water available at single point		Yes	The contractor shall arrange for construction water from underground/local sources. All borings, pipe lines, pumps, water tankers, underground storage tank, over-ground storage tank, etc, whatsoever required for taking the water from the underground source to the site of work shall be provided / erected / constructed/maintained by the contractor at his Own cost.
3.4.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
3.4.2	<u>Water supply for bidder's office, stores, canteen etc.</u>		Yes	
3.4.2.1	Making the water available at single point		Yes	
3.4.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
3.5.0	<u>LIGHTING</u>			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.5.1	For construction work (supply of all the necessary materials) 1. At office storage area 2. At the preassembly area 3. At the construction site /area		Yes	
3.5.2	For construction work (execution of the lighting work/ arrangements) 1. At office storage area 2. At the preassembly area 3. At the construction site /area		Yes	
3.5.3	Providing the necessary consumables like bulbs, switches, etc. during the course of construction		Yes	
3.5.4	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
3.6.0	<u>COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER</u>			
3.6.1	Telephone, internet, intranet, e-mail etc.		Yes	
3.7.0	<u>COMPRESSED AIR SUPPLY</u>			
3.7.1	Supply of Compressor and all other equipment required for compressor and compressed air system including pipes, valves, storage systems etc.		Yes	

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Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.7.2	Installation of the above system and operation and maintenance of the same.		Yes	
3.7.3	Supply of the all the consumables for the above system during the contract period		Yes	
3.8	<u>CONSTRUCTION FACILITIES</u>			
3.8.0	Engineering works for construction:			
3.8.1	Providing the construction drawings for all the works covered under this scope	Yes		
3.8.2	Drawings for construction methods and detailed shop drawings	Yes	Yes	In consultation with BHEL. Drawings for construction methods and detailed shop drawings shall be prepared by the Contractor as specified in the BOQ.
3.8.3	As-built drawings – where ever deviations observed and executed and also based on the decisions taken at site– routing of small bore pipes		Yes	In consultation with BHEL
3.8.4	Shipping lists etc. for reference and planning the activities	Yes		"
3.8.5	Preparation of site construction schedules and other input requirements		Yes	"

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl.No.	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.8.6	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments	Yes	Yes	"
3.8.7	Weekly construction schedules based on Sl. No 3.8.5		Yes	"
3.8.8	Daily construction / work plan based on Sl. No 3.8.7		Yes	"
3.8.9	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
3.8.10	Preparation of preassembly bay		Yes	
3.9	Other important Conditions regarding facilities to be provided by BHEL / Contractor i.e. Space, Construction Power and Construction Water etc.:			
3.9.1	BHEL may provide free of charge limited open space, for office & storage shed, as and where made available by Customer (THDC). It is the responsibility of the contractor to construct sheds, fabrication yard, establish batching plant, provide all utilities and dismantle and clear the site after completion of work or as and when required, as a part of his scope of work.			
3.9.2	Contractor shall be responsible for providing all necessary facilities like residential accommodation, transport, electricity, water, medical facilities etc. as required under various labour laws and statutory rules and regulations framed there under to the personnel employed by him.			
3.9.3	Construction power, for construction purposes will be provided on chargeable basis at one point near erection site, from supply point AS AND WHEN IT IS MADE AVAILABLE			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

	BY THE CUSTOMER . In the initial stages, the Contractor may have to deploy the DG sets for carrying out the tender works. Further distribution of power (when received) shall be done by contractor at his cost. All wiring must comply with local regulations and will be subject to Engineer's inspection and approval before connecting supply. The THDC tariff and tax may vary from time to time. The required Energy meter for measuring the consumption shall be provided and installed by the contractor. Any dispute regarding consumption, the BHEL engineer's decision shall be final & binding to the contractor. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc.
3.9.4	Provision of distribution lines of power and water from the central points to the required place with proper distribution boards observing the safety rules laid down by the authorities of the state shall be done by the contractor, supplying all the materials like cables, distribution board, switch boards, TPN, CBS, ELCBS/ MCCBS / Copper / Brass clamps, copper conductor, change over switches, pipes, fittings etc. at his own cost. If any failure is caused in supply of the power and water, it is the responsibility of the contractor to make alternate arrangements at his cost. The contractor shall adjust his working shift / hours accordingly and deploy additional manpower if necessary so as to achieve the targets. Any duty, deposit involved in getting the Electricity shall be borne by the bidder.
3.9.5	In case of power cuts / load shedding no compensation for idle labour or extension of time for completion of work will be given to contractor. During interruptions in regular power supply, power cut/load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown /failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency
3.9.6	Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, contractor's material storage area etc. within finally accepted rates.
3.9.7	CONTRACTOR HAS TO ARRANGE FOR CONSTRUCTION WATER BY PROVIDING SUITABLE BORE WELL WITHIN THE QUOTED RATES. Contractor to satisfy himself that the water drawn by him is fit for construction / consumption and adequately treat such water at his cost when it is not found fit for the said purposes.
3.9.8	No claim for damages will be entertained by the Company on account of interruptions of water supply or limitation of quantity of water as aforesaid or on account of the water so taken being not fit for construction purposes or on any other account in connection with such water supply.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

3.9.9	The Contractor should make arrangements for storage of sufficient quantity of water required for work.
3.9.10	The Contractor shall during the progress of the work, provide, erect and maintain at his own expenses all necessary temporary workshops, stores, consumables, offices, etc. required for the proper and efficient execution of the work. The planning, setting and erection of these buildings shall have the approval of the Engineer and the Contractor shall at all times keep them tidy and in a clean and sanitary condition to the entire satisfaction of the Engineer.
3.9.11	On completion of work or as and when required by BHEL, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, same will be got done by the Engineer and expenses incurred shall be recovered from the contractor along with prevailing overhead. The decision of BHEL Engineer in this regard shall be final.
3.9.12	DRINKING WATER – Bidder shall provide drinking water at the work spot at their cost.
3.9.13	CONSUMABLES All consumables, like gas, electrodes, chemicals, lubricants etc. required for the scope of work, shall be arranged by the contractor at his cost unless otherwise specifically mentioned in the contract. In the event of failure of contractor to bring necessary and sufficient consumables, BHEL may arrange for the same at the risk and cost of the contractor. The entire cost towards this along with overhead shall be paid by the contractor or deducted from the contractor's bills.
3.9.14	DEWATERING The bidder shall, prior to submitting his tender for the work, visit and examine the site of works and its surroundings at his own expense, and obtain & satisfy themselves about the limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping. Contractor shall ensure at all times that the work area & approach/ access roads are free from accumulation of water, so that the materials are safe and the erection/ progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL.
3.9.15	SITE ORGANISATION The contractor shall provide adequate staffing in the following areas in addition to the staffing requirements for execution as instructed/informed by BHEL: i. Overall planning, monitoring & control. ii. Quality control and quality assurance. iii. Materials management. iv. Safety, fire & security.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

	v. Industrial relations and fulfillment of labour laws and other statutory obligations.
3.9.16	The contractor shall maintain a site organization of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organization shall be reinforced from time to time, as required to make up for slippage from the schedule without any commercial implication to BHEL. The site organization shall be headed by a competent construction manager having sufficient authority to take decisions at site.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

(A) - LIST OF T & Ps TO BE ARRANGED BY THE CONTRACTOR AT HIS OWN COST:

The following indicative major Tools & Plants (T&P) shall be arranged by the Contractor for execution work, within the quoted rate.

Sl. No.	EQUIPMENT	INDICATIVE QUANTITY
1.	TRANSIT MIXER WITH MATCHING DUMPERS	4 Nos.
2.	CONCRETE PUMPS (STATIC)	3 Nos.
3.	BOOM PLACER	APR
4.	SUBMERSIBLE PUMP (DIESEL / ELEC)	2 Nos.
5.	PLC OPERATED BATCHING PLANT WITH PRINTING FACILITY (MIN 40 CUM PER HOUR) AND TIE UP WITH ANY READY MIX CONCRETE SUPPLIER FOR MEETING THE PEAK REQUIREMENTS. HOWEVER PRIOR APPROVAL OF SUPPLY THROUGH READY MIX CONCRETE SUPPLIERS FOR ITS QUALITY AND DESIGN MIX IS TO BE TAKEN FROM CUSTOMER (THDC)	1 No.
6.	MINI BATCHING PLANT CP-15	APR
7.	CRAWLER / TYRE CRANE- 75 T CAPACITY	APR
8.	CRAWLER / TYRE CRANE- 40 T CAPACITY	1 No.
9.	LIGHT CRANE 18/20 MT	1 No.
10.	Hydra 12/14 T Capacity	1 No.
11.	15/20 MT TRAILORS WITH PULLING UNIT / TRACTOR – TRAILORS	2 Nos.
12.	DE WATERING PUMP – 5/10/25/50 HP	1 Nos. EACH
13.	SLUDGE / SLURRY PUMP (DIESEL / ELEC)	1 No.
14.	POWER DRIVEN EARTH RAMMER	1 No.
15.	REINFORCEMET CUTTING / BENDING MACHINE	2 Nos.
16.	PORTABLE LIGHTING MAST / LIGHTING SYSTEM	3 Nos.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

17.	CEMENT STORAGE SHED OF MIN 300 MT CAPACITY	1 Nos.
18.	DG SET 60 kVA	1 Nos.
19.	CONCRETE MIXTURE M/C	APR*
20.	CONCRETE VIBRATORS	APR*
21.	POWER / HAND WINCHES	APR*
22.	WELDING MACHINES WITH ALL NECESSARY EQUIPMENTS	APR*
23.	HEATING OVEN	APR*
24.	PORTABLE OVENS	APR*
25.	PORTABLE GRINDING MACHINE OF VARIOUS SIZES	APR*
26.	SPRAY PAINTING EQUIPMENT	APR*
27.	PAINT THICKNESS MEASURING EQUIPMENT	APR*
28.	EXCAVATORS	APR*
29.	EARTH COMPACTOR	APR*
30.	PLATE COMPACTOR	APR*
31.	PNEUMATIC JACK HAMMER	APR*
32.	SLUDGE / SLURRY PUMP (DIESEL / ELECT)	APR*
33.	PLATE BENDING MACHINE	APR*
34.	VIBROMAX	APR*
35.	ROAD ROLLER	APR*
36.	ALL SCAFFOLDING MATERIALS	APR*
37.	PLY SHUTTERING BOARD/ STEEL SHUTTERING WITH ADEQUATE SUPPORTING STRUCTURE	APR*
38.	PIPE CUTTING MACHINE	APR*
39.	VIBRO - HAMMER / DROP HAMMER ARRANGEMENT	APR*

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

40.	HYD EXCAVATORS / POCLAINS / JCB	APR*
41.	DUMPERS	APR*
42.	DOZERS	APR*
43.	AIR COMPRESSOR	APR*
44.	WINCH WITH BUILDING HOIST	APR*
45.	WATER TANKER WITH SPRINKLER	APR*
46.	CONCRETE BREAKER	APR*
47.	DRINKING WATER TANK	APR*
48.	ALL MACHINERY REQUIRED FOR HYDRO TEST	APR*

APR*: As per Requirement

NOTES:

1. The above list – (A) is only indicative and these T&Ps may not be required for entire contract period but contractor will ensure that these T & Ps are provided as per the work requirement. **T&P Deployment schedule will be finalized at site based on the work fronts and in consultation with BHEL Engineer. Contractor have to mobilize / maintain the T& P as per the schedule notified time to time by BHEL Engineer.**
2. If any one of T&P mentioned above is not needed for proper execution of scope of work, provided contractor has not utilized BHEL free issued T&P for completing such work, no recovery from contractor shall be applicable.
3. Any additional item required in addition to above mentioned T&P for proper execution of scope of work, contractor has to arrange such T&P within quoted rate on the instruction of BHEL in writing in a reasonable period within two weeks from the written instruction from BHEL.
4. In case deployment of T&P w.r.t requirement, is delayed or deployed for a shorter period or abnormal down time of T&P or in case T&P w.r.t requirement was not deployed by the contractor as per instruction of BHEL and BHEL had to deploy either its own T&P or from outside, the recovery shall be done from the contractor as under:
 - a. In case BHEL had to deploy its own T&P, hire charges of T&P applicable for outside agencies as per extant guidelines for “Hire Charges on issue of Capital Tools & Plants” shall be recovered.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

- b. In case BHEL had to deploy the T&P from outside, actual hiring cost plus applicable overheads shall be recovered.
- c. In case the contractor does not deploy or delays deployment or major T&P with reference to schedule specified or T&P deployed is out of service for continuous more than 5 days, BHEL will recover non-refundable penalty per day in the following manner- (This recovery shall also be applicable in case BHEL does not deploy its own T&Ps or not deployed hired T&Ps)

In respect of each 75 MT crane- @ Rs 8000/- per day

In respect of each 40MT/50MT crane- @ Rs 5000/- per day

In respect of each hydra/crane 12T/14T/18MT/20 MT- @ Rs 3000/- per day

In respect of each trailer 20MT- @ Rs 2000/- per day per trailer

For the daily recovery rate for other T&P/IMTEs BHEL Engineer decision shall be final and binding on the contractor

- 5. All the tools and tackles/measuring instruments shall be duly tested/calibrated and valid certificate to that effect should be submitted to BHEL site in-charge before the start of work.
- 6. Depending upon the nature of work and availability of facilities locally, contractor may have to arrange for a temporary workshop for facilitating uninterrupted progress of work.
- 7. Necessary electrical / water / air connection required for operation of any of the tools & tackles shall be to Contractor's account.
- 8. The contractor shall arrange crane operator, diesel, petrol and other consumables required for the tools and plants, equipments etc. Preventive and routine maintenance of T & P are also to be arranged by the contractor at his cost without any delay. Required number of experienced mechanics and helpers for routine maintenance of the above cranes shall be provided by the contractor within his quoted rate.
- 9. Other terms and conditions regarding above items please also refer clause for T&P/IMTEs in SCC.
- 10. All the tools and plants required for this scope of work, except the Tools & Plants provided by BHEL are to be arranged by the contractor within the quoted rates. The list is suggestive in nature. **Any additional T & P required to meet BHEL commitments/schedule shall be arranged without any extra cost by the contractor.**
- 11. **If the work related to T & Ps mentioned above list - (A) is completed then, Engineer I / C can release the T & P during contract period / extended period if any. However, written permission shall be taken by contractor from BHEL construction Manager before releasing T&P.**

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

B- LIST OFIMTEs/MMEs REQUIRED:

SL NO	EQUIPMENT
1	TOTAL STATION
2	AUTO LEVEL AND STAFF
3	COMPRESSION STRENGTH TESTING EQUIPMENT
4	CONSTRUCTION MATERIAL TEST EQUIPMENT
5	CONCRETE CUBE MOULDS (150 X 150 X 150) mm
6	CONCRETE SLUMP CONE
7	COARSE AGGREGATE SIEVES & SAND SIEVER
8	SIEVES AND SIEVE SHAKER
9	AGGREGATE IMPACT TEST MACHINE
10	LE CHATELEIR'S APPROATUS AUTO CLAVE EQUIPMENT
11	LOS ANGES ABRASION TESTING MACHINE
12	AGGREGATE CRUSHING VALUE APPRATUS
13	THICKNESS GAUGE FOR MEASURING FLAKINESS INDEX
14	ELONGATION GAUGE
15	PYCNOMETER (FOR SPECIFIC GRAVITY OF AGGREGATES)
16	MOTORISED VIBRATION MACHINE FOR CEMENT TESTING
17	PHYSICAL BALANCE FOR LAB WORK
18	RAPID MOISTURE METER
19	VICAT APPARATUS WITH PLUNGERS FOR CEMENT TESTING
20	TOTAL STATION
21	DUMPY LEVEL UP TO 350 MM
22	CORE CUTTER TEST APPARATUS
23	CUBE MOULDS (70MM SIZE)
PROCESS CONTROL ACCESSORIES	
1	HOT AIR OVEN (TEMPERATURE RANGE 50°C TO 300°C)
2	ELECTRONIC BALANCE OF REQUIRED CAPACITY & SIZE
3	PHYSICAL BALANCE OF REQUIRED CAPACITY & SIZE
4	THERMOMETRE (RANGE 0°C TO 150°C)
5	POKER THERMOMETER (CONCRETE ROAD) OF REQUIRED RANGE
6	MEASURING JARS (100ml, 200ml, 500ml & 1000ml)
7	DIGITAL pH METER
8	DIGITAL MICROMETER

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps and MMEs to be deployed by Contractor

9	DIGITAL PAINT THICKNESS METER FOR STEEL
10	SCREW GAUGE (0.1mm – 10mm, Least Count .05)
11	DIGITAL PAINT THICKNESS METER FOR MASONRY / CONCRETE PAINTING

NOTES:

1. The above list is only indicative and these IMTEs/MMEs may not be required for entire contract period and will be provided as per need. Contractor will assess actual quantity and period of requirement based on his experience.
2. Other terms and conditions regarding above items please also refer clause for T&P/MMEs.
3. The contractor has to establish / arrange at site the field-testing facilities for testing of civil construction materials and concrete cubes for ensuring the proper quality, grade and strength of the materials used in the construction in line with approved field quality checklist of BHEL/ its client. Contractor has to submit detailed report for testing of all material used etc. All testing shall be done as per IS code specifications/ BHEL's quality plan. If further test is required by the engineer to be carried from outside laboratory, the cost of the same shall be borne by the contractor.
4. All the IMTEs /MMEs required for this scope of work, except the IMTEs / MMEs provided by BHEL, are to be arranged by the contractor within the quoted rates. **The list is suggestive in nature. Any additional IMTEs / MMEs required to be arranged by the contractor.**

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – V: T&Ps to be deployed by BHEL on Sharing Basis

5.1 THE LIST OF T&Ps BEING PROVIDED BY BHEL FOR USE OF CONTRACTOR FREE OF HIRE CHARGES ON SHARING BASIS:

Sl No.	EQUIPMENT	QUANTITY	PURPOSE	REMARKS
2	CRAWLER CRANE 135 MT	01	AS PER REQUIREMENT AT SITE AS CONFIRMED BY SITE INCHARGE	ON SHARING BASIS

NOTES:

1. **Cl.4.2.2.16 c) of SCC shall be read**

- a. **For BHEL's cranes 75 MT & above:-**Day-to-day upkeep and running maintenance like filling topping up of lubricants, changing filters, etc. including repair of self-starter, batteries and dynamo of these cranes shall be excluded from the scope of the contractor.
- b. **For BHEL's cranes below 75 MT capacity:-**Day-to-day upkeep and running maintenance like filling topping up of lubricants, changing filters, etc. including repair of self-starter, batteries and dynamo of these cranes shall be responsibility of the contractor. If on checking it is found that the same is not followed, BHEL shall exercise its right to get the job/works done at the risk and cost of the contractor.

Common for above Sl. No. (a) & (b):- In case of breakdown of crane, contractor shall provide the necessary manpower for maintenance of the BHEL owned crane to maintenance agency (deployed by BHEL), failing to do so BHEL will get the job done at the risk and cost of contractor. BHEL may also provide cranes through crane hiring agencies in which case the day-to-day upkeep and running maintenance shall be excluded from scope of contractor. The contractor shall arrange fuel for the operation of hired & BHEL owned cranes also.

2. **Cl.4.2.2.16 e) of SCC Shall be read as**

- a. **For BHEL's cranes 75 MT & above:-** The operator, helper & maintenance personal (Engineer/Technician/OEM) for BHEL's cranes 75 MT & above capacity being provided by BHEL free of cost. Further fuel for operation of all BHEL cranes shall be provided by contractor without any extra cost.
- b. **For BHEL's cranes below 75 MT capacity:-**The operators for BHEL's cranes 75 MT below capacity shall be provided by the contractor free of cost. These operators should possess valid license for heavy vehicle. Further fuel for operation of all BHEL cranes shall be provided by contractor without any extra cost.

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Chapter – V: T&Ps to be deployed by BHEL on Sharing Basis

3. The Cranes at SI No 1 & 2 will be provided as per requirement & availability for special package handling only at the sole discretion of the BHEL Engineer.
4. The contractor shall make necessary arrangement like lying of special sleeper beds, assembly & dismantling of heavy lift attachment, boom, jib etc. for movement and operation of crane.
5. Other T&P mentioned above, contractor shall transport from BHEL stores, install, operate, carry out maintenance, dismantle after use and return to BHEL stores.
6. Cranes provided by BHEL will be on sharing basis with other agencies / contractors of BHEL. The allocation of cranes shall be the discretion of BHEL engineer, which shall be binding on the contractor. Cranes will be deployed at appropriate time as decided by BHEL for suitable duration and intended purpose. Augmentation of BHEL T & P under special circumstances shall be discretion of BHEL.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VI: Time Schedule

6.0	TIME SCHEDULE (MOBILIZATION, TIME SCHEDULE, CONTRACT PERIOD)
6.1	INITIAL MOBILIZATION After receipt of Letter of Award (LOA), Contractor shall discuss with Project Manager / Construction Manager regarding initial mobilization. Contractor shall mobilize necessary resources within 4 weeks of issue of letter of intent or as per the directive of Project Manager / Construction Manager. Such resources shall be progressively augmented to match the schedule of milestones as directed by BHEL Engineer.
6.1.1	The activities for construction, erection etc. shall be started as per directions of Construction Manager of BHEL. Contractor shall mobilize further resources (in addition to those required for activities under clause no. 6.1.1) as per requirement to commence the work and progressively augment the resources to match schedule of the project. During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.
6.2	START DATE / ZERO DATE The schedule date of start of work shall be the date after 4 weeks of issue of LOA; The Actual Date of Start of Contract Period (Zero Date) shall be date of handing over of site to contractor for work and shall be certified by the BHEL Engineer.
6.3	COMPLETION PERIOD: Entire work as detailed in tender specification shall be completed within 22 (Twenty Two) months from the actual date of start of work as per the programs / milestones indicated by BHEL. Contractor has to mobilize adequate resources to meet BHEL's commitments to their customer as indicated from time to time. In the event the contractor fails to respond to these requirements, BHEL shall take appropriate actions to meet customer's commitments in line with the provisions of General Conditions of Contract.
6.3	In case due to reasons not attributable to the contractor, the work gets delayed and scheduled completion gets extended, time extension will be granted by BHEL as per clause no. 2.11 of GCC.
6.4	The work under the scope of this contract is deemed to be completed in all respects, only when all the works are carried out as per satisfaction of BHEL. The decision of BHEL on completion date shall be final and binding on the contractor.
6.5	In order to meet above schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL without any extra cost to BHEL. Bidder has to start the parallel working at various available fronts. Required resources like manpower, T&Ps, etc are to be mobilized by bidder to take up all parallel working as instructed by BHEL engineer. Subject package is a critical package and same is urgently

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VI: Time Schedule

	required for the synchronization of power plant. Bidder has to take care of this during the execution of work.						
6.6	CONTRACT PERIOD: The contract period for completion of entire work under scope of this contract shall be 22 (Twenty Two) Months from the actual / zero date of start of work.						
6.7	The Milestones are as under: <table><tr><th>Mile Stone</th><th>Schedule from Zero date</th></tr><tr><td>Completion of CW Duct works for Unit#1 including all Hydro test and encasing</td><td>Within 16 months</td></tr><tr><td>Completion of CW Duct works for Unit#2 including all Hydro test and encasing</td><td>Within 22 months</td></tr></table>	Mile Stone	Schedule from Zero date	Completion of CW Duct works for Unit#1 including all Hydro test and encasing	Within 16 months	Completion of CW Duct works for Unit#2 including all Hydro test and encasing	Within 22 months
Mile Stone	Schedule from Zero date						
Completion of CW Duct works for Unit#1 including all Hydro test and encasing	Within 16 months						
Completion of CW Duct works for Unit#2 including all Hydro test and encasing	Within 22 months						
6.8	SUBMISSION OF L3 SCHEDULE The contractor shall submit a detailed area/structure wise L3 schedule within 15 days in consultation with BHEL based on the tentative schedule provided as per the clause 6.7. The detailed L3 schedule shall be approved by BHEL and same shall be implemented. Bidder shall submit L3 schedule in MS Projects to meet the agreed project schedule covering various milestone activities and their split up details such as construction, procurement of materials, fabrication & erection activities. This schedule shall also clearly indicate the interface facilities/inputs to be commenced from the date of completion of the whole of the work in the package, certified by the Engineer.						
6.9	CONSEQUENCE OF DELAY It may be noted that in the event, delay in completion is attributable to the contractor; BHEL will impose LD on the contractor as per clause no. 2.7.9 of GCC.						

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VII: Terms of Payment

7.0	TERMS OF PAYMENT
7.1	The 'Engineer' will certify regarding the actual work executed in the measurement books and bills, which shall be accepted by the contractor in measurement book.
7.2	The Contractor shall be paid monthly running bill as per chapter – X of SCC and Clause Nos. 2.22 & 2.23 of GCC. The format for billing shall be approved by BHEL before raising invoices.
7.3	The contractor on certification of the engineer at site is entitled for payments of his running bills which shall be subject to any deduction/retention specifically under clauses 2.22 of GCC and 10.0 of SCC.
7.4	BHEL will release the payment through Electronic Fund Transfer (EFT)/RTGS
7.5	Final bill shall be submitted after completion of works and upon material reconciliation along with all prescribed formats.

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Chapter – VIII: Taxes & Duties

8.0 TAXES AND DUTIES:

8.0	TAXES & DUTIES
8.1	The contractor shall pay all (save the specific exclusions as enumerated in this clause) taxes, fees, license, charges, deposits, duties, tools, royalty, commissions, other charges, etc. which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract. In case BHEL is forced to pay any of such taxes/duties, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit. However, provisions regarding GST on output supply (goods/service) and TDS/TCS as per Income Tax Act shall be as per following clauses.
8.2	GST (Goods and Services Tax)
8.2.1	GST as applicable on output supply (goods/services) are excluded from contractor's scope; therefore, contractor's price/rates shall be exclusive of GST. Reimbursement of GST is subject to compliance of following terms and conditions. BHEL shall have the right to deny payment of GST and to recover any loss to BHEL on account of tax, interest, penalty etc. for non-compliance of any of the following condition.
8.2.2	The admissibility of GST, taxes and duties referred in this chapter or elsewhere in the contract shall be limited to direct transactions between BHEL & its Contractor. BHEL shall not consider GST on any transaction other than the direct transaction between BHEL & its Contractor.
8.2.3	Contractor shall obtain prior written consent of BHEL before billing the amount towards such taxes. Where the GST laws permit more than one option or methodology for discharging the liability of tax/levy/duty, BHEL shall have the right to adopt the appropriate one considering the amount of tax liability on BHEL/Client as well as procedural simplicity with regard to assessment of the liability. The option chosen by BHEL shall be binding on the Contractor for discharging the obligation of BHEL in respect of the tax liability to the Contractor.
8.2.4	Contractor has to submit GST registration certificate of the concerned state. Contractor also needs to ensure that the submitted GST registration certificate should be in active status during the entire contract period.
8.2.5	Contractor/Vendor has to issue invoice indicating HSN/SAC code, Description, Value, Rate, applicable tax and other particulars in compliance with the provisions of relevant GST Act and Rules made thereunder.
8.2.6	Vendor has to submit GST compliant invoice within seven days from the due date of invoice as per GST Law. In case of delay, BHEL reserves the right of denial of GST payment if there occurs any hardship to BHEL in claiming the input thereof. In case of goods, vendor has to provide scan copy of invoice & GR/LR/RR to BHEL before movement of goods starts. Special care should be taken in case of month end transactions.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VIII: Taxes & Duties

8.2.7	Vendor has to ensure that invoice in respect of such services which have been provided/completed on or before end of the month should not bear the date later than last working day of the month in which services are performed.
8.2.8	Subject to other provisions of the contract, GST amount claimed in the invoice shall be released on fulfilment of all the following conditions by the Contractor: - - Supply of goods and/or services have been received by BHEL. - Original Tax Invoice has been submitted to BHEL. - Contractor/ Vendor has submitted all the documents required for processing of bill as per contract/ purchase order/ work order. - In cases where e-invoicing provision is applicable, vendor/contractor is required to submit invoice in compliance with e-invoicing provisions of GST Act and Rules made thereunder. - Contractor has filed all the relevant GST return (e.g. GSTR-1, GSTR-3B, etc.) pertaining to the invoice submitted and submit the proof of such return along with immediate subsequent invoice. In case of final invoice/ bill, contractor has to submit proof of such return within fifteen days from the due date of relevant return. - Respective invoice has appeared in BHEL's GSTR - 2A for the month corresponding to the month of invoice. Alternatively, BG of appropriate value may be furnished which shall be valid at least one month beyond the due date of confirmation of relevant payment of GST on GSTN portal or sufficient security is available to adjust the financial impact in case of any default by the contractor. - Contractor has to submit an undertaking confirming the payment of all due GST in respect of invoices pertaining to BHEL.
8.2.9	Any financial loss arises to BHEL on account of failure or delay in submission of any document as per contract/purchase order/work order at the time of submission of Tax invoice to BHEL, shall be deducted from contractor's bill or otherwise as deemed fit.
8.2.10	TDS as applicable under GST law shall be deducted from contractor's bill.
8.2.11	Contractor shall comply with the provisions of e-way bill wherever applicable. Further wherever provisions of GST Act permits, all the e-way bills, road permits etc. required for transportation of goods needs to be arranged by the contractor.
8.2.12	Contractor shall be solely responsible for discharging his GST liability according to the provisions of GST Law and BHEL will not entertain any claim of GST/interest/penalty or any other liability on account of failure of contractor in complying the provisions of GST Law or discharging the GST liability in a manner laid down thereunder.
8.2.13	In case declaration of any invoice is delayed by the vendor in his GST return or any invoice is subsequently amended/altered/deleted on GSTN portal which results in

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VIII: Taxes & Duties

	any adverse financial implication on BHEL, the financial impact thereof including interest/penalty shall be recovered from the Contactor's due payment.
8.2.14	Any denial of input credit to BHEL or arising of any tax liability on BHEL due to non-compliance of GST Law by the Contractor in any manner, will be recovered along with liability on account of interest and penalty (if any) from the payments due to the Contactor.
8.2.15	In the event of any ambiguity in GST law with respect to availability of input credit of GST charged on the invoice raised by the contractor or with respect to any other matter having impact on BHEL, BHEL's decision shall be final and binding on the contractor.
8.2.16	<u>Variation in Taxes & Duties:</u> Any upward variation in GST shall be considered for reimbursement provided supply of goods and services are made within schedule date stipulated in the contract or approved extended schedule for the reason solely attributable to BHEL. However downward variation shall be subject to adjustment as per actual GST applicability. In case the Government imposes any new levy/tax on the output service/goods after price bid opening, the same shall be reimbursed by BHEL at actual. The reimbursement under this clause is restricted to the direct transaction between BHEL and its contactor only and within the contractual delivery period only. In case any new tax/levy/duty etc. becomes applicable after the date of Bidder's offer but before opening of the price Bid, the Bidder/Contractor must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of price bid. Claim for any such impact after opening the price bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.
8.3	<u>Income Tax:</u> TDS/TCS as applicable under Income Tax Act, 1961 or rules made thereunder shall be deducted/collected from contractor's bill.

8.4	BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998.
	In case any portion of work involves execution through building or construction workers, then compliance to the above titled Acts shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – VIII: Taxes & Duties

	circumstances it may be ensured as under:-
8.4.1	It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a licence to the Competent Authority under the BOCW Act and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of licence / permission to BHEL within a period of one month from the date of award of contract.
8.4.2	It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these act and rules including that of payment / deposit of 1% cess on gross payment made for value of work involving building or construction workers engaged by the contractor within a period of one month from the receipt of payment.
8.4.3	It shall be the responsibility of the sub-contractor to furnish the receipts /challans towards deposit of the cess together with the number, name and other details of beneficiaries (building workers) engaged by the sub-contractor during the preceding month.
8.4.4	It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.
8.4.5	The contractor shall, however ensure before deposit of any BOCW Cess, that customer is not depositing the same in order to avoid excess deposit of cess.
8.4.6	The contractor shall bear cost of BOCW cess either by way of deposit or through recovery by BHEL in case the same is deposited by the customer.
8.4.7	In case of failure in above mentioned compliances, BOCW Cess @ 1% as well as applicable penalty as specified in BOCW Act/Rules shall be deducted from the contractor.

Note:

1	The Gross amount is to be construed as cost of construction in line with the provisions of the BOCW of the BOCW Cess act and in case of compliance by customer by way of deduction at source in line with clause No 3(2) of the act an equitable adjustment to the relatable cost of construction attributable to the bidder shall be made in terms of clause no 8.2 of TCC
2	In case compliance by customer by way of deduction at source in line with clause no 3(2) is not resorted to, the compliance of BOCW Cess act shall be ensured by the bidder in line with the provisions of BOCW Cess act in terms of clause no 8.2.2b of TCC

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3	The bidder may consider the cost of construction for levy of BOCW Cess inclusive of GST, however, due to whatsoever reason if the GST does not form the cost of construction for levy of aforesaid Cess an equitable adjustment thereof shall be made to the contract price.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-IX: Materials and Other Requirements

9.0	MATERIALS
9.1	The contractor shall at his own expenses provide all materials including consumables, paints, welding electrodes etc. required for the work. However for permanent works cement, reinforcement steel, structure steel and prefabricated CW Duct will be issued free of cost as per BOQ cum Rate Schedule, terms & conditions specified in clause No. 9.14 from BHEL / Customer stores or at a point instructed by BHEL.
9.2	All materials to be provided by the Contractor shall be of the best kind in conformity with the specifications laid down in the contract or as per relevant Indian standard and the Contractor shall, if requested by the BHEL Engineer, furnish proof to the satisfaction of BHEL Engineer that the materials so comply.
9.3	The Contractor shall, at his own expense and without delay, supply to the BHEL Engineer, samples of materials proposed to be used in the works. The BHEL Engineer shall within seven days of supply of samples or within such further period as he may require will intimate to the Contractor in writing, whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the BHEL Engineer for his approval fresh samples complying with the specifications laid down in the Contract. Any delay in approval of samples (original or fresh ones) shall not make the contractor eligible for any compensation.
9.4	The BHEL Engineer shall have full powers for removal of any or all of the materials brought to site by the Contractor which are not in accordance with the Contract specifications or do not conform in character or quality to samples approved by him. In case of default on the part of the Contractor in removing rejected materials, the BHEL Engineer shall be at liberty to have them removed by other means. The BHEL Engineer shall have full powers to procure other proper material to be substituted for rejected materials and in the event of the Contractor refusing to comply; he may cause the same to be supplied by other means. All costs, which may attend upon such removal and / or substitution, shall be borne by the Contractor.
9.5	The Contractor shall indemnify BHEL, its representatives or employees against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties or other charges which may be payable in respect of any article or material or part thereof included in the Contract. In the event of any claim being made or action being brought against BHEL or any agent, servant or employee of BHEL in respect of any such matters as aforesaid, the Contractor shall immediately be notified thereof, provided that such indemnity shall not apply when such infringement has taken place in complying with the specific directions issued by BHEL but the Contractor shall pay any royalties or other charges payable in respect of any such use, the amount so paid being reimbursed to the Contractor only if the use was the result of any drawings / specifications issued after submission of the tender.

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9.6	The BHEL Engineer shall be entitled to have tests carried out as specified in the Contract for any materials supplied by the Contractor other than those for which, as stated above, satisfactory proof has already been furnished, at the cost of the Contractor and the Contractor shall provide at his expense all facilities which the Engineer may require for the purpose. If no tests are specified in the Contract, and such tests are required by BHEL Engineer, the Contractor shall provide all facilities required for the purpose and the charges for these tests shall be borne by the Contractor only. The cost of materials consumed in tests shall be borne by the Contractor in all cases except when otherwise provided.
9.7	In addition, the Contractor shall perform / submit at his own cost such tests / samples as may be required by the BHEL Engineer out of the materials used by the company except for the costs of materials used in such tests/ samples.
9.8	After acceptance of the Contract, if Contractor desires BHEL to supply any other materials, such material may be supplied by BHEL, if available, at rates to be fixed by the BHEL Engineer along with prevailing departmental charges. BHEL reserve the right not to issue any material. The non-issue of such material will not entitle the Contractor for any compensation whatsoever either in time or in cost.
9.9	Material required for the works, whether brought by the Contractor or supplied by BHEL, shall be stored by the Contractor only at places approved by BHEL Engineer. Storage and safe custody of material shall be the responsibility of the contractor.
9.10	BHEL's officials concerned with the Contract shall be entitled at any time to inspect and examine any materials intended to be used in or on the works, either on the Site or at factory or workshop or other place(s) where such materials are assembled, fabricated, manufactured or at any place (s) where these are lying or from which these are being obtained and the Contractor shall give such facilities as may be required for such inspection and examination.
9.11	All materials brought to the Site shall become and remain the property of BHEL and shall not be removed off the Site without the prior written approval of the BHEL Engineer. But whenever the Works are finally completed and advance, if any, in respect of any such material is fully recovered, the Contractor shall at his own expense forthwith remove from the Site all surplus material originally supplied by him and upon such removal, the same shall re-vest in and become the property of the Contractor.
9.12	It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc. before procurement of welding electrodes / TIG wires. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch No. date of expiry etc. and produce test certificate for each lot / batch with correlation of batch / lot no. with respective test certificate. No electrode will be allowed to be used without valid test certificate.

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Chapter-IX: Materials and Other Requirements

9.13	All charges on account of Octroi, terminal or sales tax and other duties on material obtained for the works from any source shall be borne by the contractor.
9.14	ISSUE AND ACCOUNTING OF CEMENT, STEEL.
9.14.1	Cement, steel (reinforcement & structure) will be issued as free issue materials from BHEL / THDC site stores or other issuing points as specified by the Engineer. Such issues would be only for permanent works. Necessary indents shall be raised by the contractor as per procedure laid down by the Engineer-in-Charge about 7 days in advance of the actual requirement for incorporation in the works.
9.14.2	Materials will be issued only for permanent works and not for making templates, other temporary works, enabling works etc. and the same shall not be taken into account for purpose of material reconciliation.
9.14.3	The contractor shall bear all other costs including the unloading of material from supplier's vehicle at site store, further lifting, carting from issue points to works site / contractor's stores, custody and handling etc. and return of surplus / serviceable materials to BHEL's stores to be designated by the Engineer-in-charge and all expenditure will be made by the contractor.
9.14.4	All steel shall be issued in available lengths / shapes and no claims for extra payment on account of issue of non-standard lengths / shapes will be entertained. For the purpose of billing and accounting only linear measurement will be taken and weight will be calculated as per the IS Co-efficient. The different in unit weight as per IS and actual as issued, if any shall be to the contractor's account and contractor shall quote the rates for corresponding item to take care of such difference.
9.14.5	Cement, as received from the Manufacturer / Stockiest will be issued to the contractor. The theoretical weight of each bag of cement for issue purpose will be considered as 50Kgs. Per Bag. Any type of cement and in any container as received from Manufacturer / Stockiest shall be issued to the contractor. No claim whatsoever shall be entertained on this. Cement bags weighing up to 4% less will be accepted by the contractor and accounted for as 50Kg per bag.
9.14.6	The Contractor shall maintain good stores for storing the cement issued to him. The flooring of the storage house, the clearance of cement bags from the sidewalls etc., shall be as per the instructions of the Engineer-in-charge.
9.14.7	The cement stores shall be open for supervision and verification by the Engineer-in-charge or his authorized representative by any time when the Engineer-in-charge feels the need to do so.
9.14.8	In the case of steel materials, the same shall be issued generally on the basis of linear measurement and the corresponding weight will be calculated as per Indian Standard. For the purpose of billing & accounting, only linear measurement will be taken and any difference in weight based on linear measurement & actual weight shall be to contractor's account. Quoted price shall be deemed to include the above & the permissible wastage mentioned. No claim

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Chapter-IX: Materials and Other Requirements

	whatsoever shall be entertained on account of wastage & difference in weight as referred to above.		
9.14.9	Issue of stores material is subject to availability and the contractor shall not be entitled to any claim or compensation for non-supply or delay in the supply under any circumstances. The material will be issued generally during the working hours.		
9.14.10	The Contractor will have to submit their design mix for different grades of Concrete keeping in view the requirements stipulated in IS:456, specifically regarding slump and Water Cement ratio and Specific Gravity of Materials brought to site as analyzed in the laboratories. The design shall be used upon absolute volume method and theoretical consumption of Cement shall be worked out on this basis. For other than above designated mix Concrete items, the coefficients for consumption of cement shall be adopted as per CPWD practice. The theoretical consumption of cement thus worked out shall be binding upon the Contractor for reconciliation of Cement issued by the Owner. For any excess /under consumption based on these coefficients, the Contractor shall be penalized as per contract provisions. Though, permissible wastage specified shall be considered, while effecting penal recovery, no other allowance whatsoever shall be taken for reconciliation purposes.		
9.14.11	The theoretical consumption of cement, reinforcement steel and structural steel required for the work will be calculated on the basis of approved drawings / joint measurements. In the case of cement, the theoretical consumption shall be decided by the Engineer as mentioned above and his decision in this regard shall be final and binding on the Contractor. Reinforcement and structural steel shall be measured by weight in tones. The weight will be arrived at by multiplying the used length by the sectional weight. The sectional weight will be same as were applied at the time of issue. Standard hooks, cranks, bends and authorized laps, chairs, separator pieces etc. specified in drawing or instructed by engineer as required shall be measured and paid for. No payment shall be made for binding wires, spacer block etc. required for keeping the steel in position unless otherwise specified in the contract. No extra payment will be made for modification of already embedded reinforcement, if required due to faulty fabrication or placement.		
9.14.12	The contractor shall submit proper account of material / material reconciliation statement for the material drawn by him ~~from stores~~ once in every three months. Failing compliance of this requirement further issue of steel to the contractor may be suspended and no claim of compensation for delay in execution on this account shall be entertained.		
9.14.13	All the cement & reinforcement steel thus issued shall be properly accounted for as per the following permissible wastage over the theoretical quantity / consumption incorporated in the works.		
	Item	Area	Permissible Variation / Wastage
	Cement	For All works	1.5%

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Chapter-IX: Materials and Other Requirements

	Reinforcement Bars & MS Earthing Rods	For All works	3%
	Structural Steel	For All Works	4%
9.14.14	Any unused / serviceable quantity of cement, reinforcement steel & structural steel not returned in good condition & wastages / loss / consumption beyond specified / agreed limits shall be charged at penal rate of Rs 7000 per MT for cement, Rs 60,000 per MT for reinforcement steel, Rs 70,000 per MT for structural steel and 105% BHEL's purchase cost of CW Duct/CW pipe at the time of preparing final bill, during finalization of the contract. The decision of Engineer-in-charge with regard to applicability of penal rates shall be final & binding upon the contractor.		
9.14.15	For the materials i.e. Reinforcement (TMT), Structure Steel, CW ducts being issued free of cost, the scrap generated shall belong to BHEL.		
9.14.16	Empty cement bags shall be the property of contractor and recovery @ 01/- (Rs. One only) per empty cement bag shall be made from their RA bills.		
9.14.17	SCRAP & SERVICEABLE MATERIALS: All reinforcement steel / Structural steel (rolled sections) of length above 2 M shall be considered as serviceable materials provided the materials be in good and acceptable condition. Structural Steel / Reinforcement steel in length less than 2 M shall be treated as scrap. All plates/ sheets of size above 2 SQM shall be considered as serviceable materials provided the materials be in good and acceptable condition. All plates and sheets below the size of 2 SQM shall be treated as scrap.		

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Chapter-X: Other Important Conditions

10.1	EXECUTION OF WORK
10.1.1	The work shall be executed in a workman like manner and to the entire satisfaction of the Engineer and as per technical specification issued with tender, IS codes, technical specifications as applicable. In case of conflict, the decision of the Engineer I/c shall be final & binding.
10.1.2	The Engineer I/c will communicate or confirm his instructions to the Contractor in respect of the execution of the work in a "Work Site Order Book" maintained at his office and the Contractor shall visit this office daily and shall confirm receipt of such instructions by signing the relevant entries in this book or through e-mail. Such entries / e-mails will rank as order or notices in writing within the intent and meaning of these conditions.
10.1.3	Only BHEL approved make of electrodes will be used. All electrodes shall be heated and dried in the electric electrode drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot. The electrodes brought to site will have valid manufacturing test certificate. The test certificate will have co-relation with the lot no. / batch no. given on electrode packets. No electrodes will be allowed to be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards) will be submitted to BHEL before putting the oven in use. Periodical calibration for the same shall also be arranged by the contractor within the finally accepted rates.
10.1.4	Contractor shall execute the work as per sequence and procedure prescribed by BHEL at site. The applicable erection manuals which are available with BHEL site office are to be referred for compliance and guidance before taking up the work. Any rework on this failure to comply with will be to account of contractor only. BHEL engineer, depending upon the availability of materials, fronts etc., will decide the sequence of erection and methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the method of erection adopted in erection of similar jobs in other projects or for any reason whatsoever.
10.1.5	The work shall conform to dimensions and tolerances specified in the various drawings / documents that will be provided during various stages of erection. If any portion of work is found to be defective in workmanship, not conforming to drawings or other stipulations due to Contractor's fault, the Contractor shall dismantle and re-do the work duly replacing the defective materials at his cost, failing which the work will be got done by BHEL and recoveries will be effected from the Contractor's bills towards expenditure incurred including cost of materials and departmental overheads of BHEL as per GCC.
10.1.6	On completion of work, all the temporary buildings, structures, scaffolding, cables etc. shall be dismantled and levelled and debris shall be removed as per instructions of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

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Chapter-X: Other Important Conditions

10.2	SETTING OUT
10.2.1	All the works shall be set out to the true lines, grades and elevation indicated on the drawing. The contractor shall be responsible to locate and set out the works. Only one grid reference line and bench mark all be made available for setting out the works under the contract. This reference lines shall be used as datum for the works under the contract and the contractor has to establish for his work area at available points horizontal and vertical control points. The contractor shall inform BHEL well in advance of the times & places at which he wishes to do work in the area allotted to him so that suitable datum points established by him are checked by BHEL / Customer to enable the contractor to proceed with the works. Any work done without being properly located may be removed and / or dismantled by BHEL / Customer at contractor's expense.
10.2.2	The contractor shall at his own expense take all proper and responsible precautions to preserve and maintain these datum marks to its true position. In the event of these marks being disturbed or obliterated by accident or due to any other cause whatsoever, the same may be deemed necessary placed by BHEL / Customer at contractor's expenses.
10.3	SITE DRAINAGE
10.3.1	All water including sub-soil water which may accumulate on the Site during the progress of the works or in trenches and excavations, including monsoon period shall be removed by the contractor from the Site to the satisfaction of the Engineer. It will also be responsibility of the contractor to de-water all the foundation pits, trenches with suitable de-watering methods like, pumping out, well point system etc. considering the depth of water table at plant site. All such expenditure on de-watering shall be deemed to be included in quoted rates. Vendor has to arrange and maintain adequate no. of Diesel & electrical pumps of suitable capacities, operators, necessary manpower with sufficient quantity of suction& discharges hoses, pipes, Clamps, cables, Electrical panels/starters, diesel, consumables without any extra commercial implication on BHEL treating as normal scope of work. Dewatering pumps will be required to run to ensure job progress is not hampered & if required pumps are to be run on round the clock basis on working days & holidays, Sundays.
10.4	INSPECTION AND STAGE APPROVAL OF THE WORK
10.4.1	The owner or his duly authorized representative shall have at all reasonable times access to the contractor's premises or works and shall have the power to inspect drawings or any portion of the work, examine the materials and workmanship and shall have the authority to reject any work. This would be implemented through joint

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Chapter-X: Other Important Conditions

	inspection by the representative of the owner and BHEL and in the form of joint protocols without any extra claims and loss of time and amount.
10.4.2	All work embracing more than one process shall be subject to examination and approval at each stage thereof and the Contractor shall give due notice in writing to the Engineer when each stage is ready. In default of such notice being received, the Engineer shall be entitled to approve the quality and extent thereof at any time he may choose and in the event of any dispute, the decision of the Engineer thereon shall be final and conclusive.
10.5	UNCOVERING AND MAKING GOOD
10.5.1	The Contractor shall uncover any part of the Works and/or make openings in or through the same as the Engineer may from time to time direct for his verification and shall reinstate and make good such part to the satisfaction of the Engineer. If any such part has been covered up or put out of view after being approved by the Engineer and is subsequently found on uncovering to be executed in accordance with the Contract, the expenses of uncovering and / or making opening in or through, reinstating and making good the same shall be borne by BHEL. In any other case all such expenses shall be borne by the Contractor.
10.6	DISCREPANCIES AND ADJUSTMENT OF ERRORS
10.6.1	The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small-scale drawings and figures dimensions in preference to scale and special conditions in preference to general conditions.
10.6.2	In case of discrepancies between schedules of quantities, the specification and / or the drawings, the following order of preference shall be observed. (a) Description in schedule of quantities. (b) Technical Conditions of Contract. (c) Drawings. (d) Technical Specifications (e) Special Conditions of Contract (f) General conditions of contract
10.6.3	If there are varying or conflicting provisions made in any one document forming part of the contract, the Engineer shall be the deciding authority with regard to the document.

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10.6.4	Any error in description, quantity in schedule of quantities or any omission there from shall not vitiate the contract or release the contractor from the execution of the whole or any part of the works comprised therein according to the drawings and specifications or from any of his obligations under the contract.
10.7	MATERIAL OBTAINED FROM EXCAVATION
10.7.1	Valuable Materials / Archeologically important materials of any kind obtained from excavation on the Site shall remain the property of BHEL / its client and shall be disposed of as the Engineer may direct, at no extra cost.
10.8	SAFETY CODE
10.8.0	The contractor shall comply with following towards Safety and Social Accountability.
10.8.1	Besides provision with regard to SAFETY under Clause 9.0 of SCC, the contractor will be responsible for Health, Safety & Environment management at site for the construction activities to be carried out by them. The contractor shall continuously take special care to ensure the safety and prevention of human and equipment accidents and maintain good sanitary conditions in and around the site. All the construction work and plant operation must be carried out in the safest possible manner. The Engineer reserves the right to stop any process which, in the Engineer's opinion, is being performed dangerously. In this case the contractor must immediately adhere the requisite safety precautions and any delays attributed to the work stoppage on this account shall not affect the agreed contractual finishing dates.
10.8.2	HSE plan for site operation by Sub Contractor (Doc No. HSEP 14 attached) shall be followed.
10.8.3	Contractor has to abide all the statutory guidelines issued by Government in respect of COVID-19. All the necessary PPEs or other facility required at site in respect of COVID-19 is to be arranged by the bidder within the quoted rates.
10.8.4	Contractor shall make necessary arrangements to ensure following : - Contractor has to maintain contact with local hospital having ambulance facility, scanning & other ultra-modern medical facilities required during emergency. - Contractor has to ensure pre-employment medical check for all staff & workers.
10.8.5	EMERGENCY VEHICLE: Contractor shall arrange / tie-up with nearest Hospital / Nursing Home to deal with any emergency situation including arrangement of ambulance as and when needed.
10.9	NUISANCE

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10.9.1	The Contractor shall not at any time do, cause or permit any NUISANCE on Site or do anything which shall cause unnecessary disturbance or inconvenience to owners, tenants or occupiers of other properties near the Site and to the public generally.
10.10	TREASURE , TROVE , FOSSILS etc.
10.10.1	All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the absolute property of BHEL / BHEL's client and the Contractor shall take reasonable precautions to prevent his workmen or any other person from removing or damaging any such article or thing, shall immediately upon discovery thereof and before removal acquaint the Engineer with such discovery and carryout the Engineer's directions as to the disposal of the same.
10.11	PROTECTION OF WORKS
10.11.1	Trees designated by the Engineer shall be protected from damage during the course of the Works and earth level within 1 meter of each such tree shall not be charged. Where necessary, such trees shall be protected by providing temporary fencing.
10.11.2	The contractor shall provide and maintain at his own expense all lights, guards, fencing and watching when and where necessary or required by the Engineer for the protection of the Works or for the safety and convenience of those employed on the Works or the public.
10.11.3	The contractor shall have total responsibility for protecting his works till it is finally taken over by the Engineer. No claim will be entertained by the Engineer for any damage or loss to the contractor's works and the contractor shall be responsible for the complete restoration of the damaged works to its original condition to comply with the specifications and drawings. Should any such damage to the contractor's works occur because of other party not under his supervision or control, the contractor shall make his claim directly with the party concerned. The contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.
10.12	RECORD FOR MATERIALS CONSUMED
10.12.1	The contractor shall maintain and furnish to the Engineer the RECORD OF MATERIALS consumed in the works for each activity. The statement showing the theoretical vis-à-vis actual consumption of specified materials, such as structural /reinforcement steel, cement, bitumen, lead, paint etc., shall be enclosed along with the running bills submitted by the contractor. Contractor has to also furnish the test results of the materials used in the work as per IS specifications.
10.13	PROTECTION OF EMBEDMENTS, BOLTS ETC.

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10.13.1	The contractor shall ensure proper protection to the satisfaction of the Engineer, of all bolts, inserts, embedment etc. from weather etc./ by greasing, rapping them with gunny bags or canvas or by any other means as directed by Engineer. Cost of such protections shall be deemed to be included in the rates quoted for the item.
10.14	COMPLETION OF WORK AND COMMENCEMENT OF GURANNTÉE PERIOD
10.14.1	The works shall be completed to the entire satisfaction of the Engineer and in accordance with the completion schedule as specified in the Contract, and all unused stores and materials, tools, plant, equipment, temporary buildings, site office, labor hutments and other things shall be removed and the site and work cleared of rubbish and all waste materials and delivered up clean and tidy to the satisfaction of the Engineer at the Contractor's expenses.
10.14.2	BHEL shall have power to take over from the Contractor from time to time such sections of the work as have been completed to the satisfaction of the Engineer. Such work however shall not be treated as have been completed until the extra / pending works are executed to the satisfaction of Engineer.
10.14.3	The Engineer shall certify to the contractor the date on which the work is completed and the date thereof for commencement of Guarantee Period. Guarantee Period shall be as given in GCC.
10.15	CLEARANCE OF SITE AND REPAIRS.
10.15.1	Contractor has to clear the site / area where mechanical and electrical erection work is to be commenced / or in progress. The contractor shall remove construction materials and equipment lying in the vicinity and causing obstruction in the erection work within 24 hrs notice. In case, he fails to clear the site, this will be done at his risk & cost by BHEL.
10.16	QUALITY ASSURANCE
10.16.1	Contractor shall prepare a Field Quality Plan (FQP) for this tender's scope, in consultation with BHEL and submit to BHEL / Customer for approval. All works shall be carried out in accordance of the approved Field Quality Plan for this work. The contractor has to establish / arrange at site the field-testing facilities for testing of civil construction materials and concrete cubes for ensuring the proper quality, grade and strength of the materials used in the construction in line with approved field quality checklist of BHEL/ its client. Contractor has to submit detailed report for testing of all material used etc. All testing shall be done as per IS code specifications/ BHEL's quality plan. If further test is required by the engineer to be carried from outside laboratory, the cost of the same shall be borne by the contractor.
10.17	NA
10.18	METHOD OF MEASUREMENT

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10.18.1	Method of measurements shall be as per technical specifications included in the tender. For other items measurements shall be as per relevant IS Codes.
10.19	DEVIATION
10.19.1	The Contractor shall not make any alteration in, addition to or omission from the work as described in the tender documents except in pursuance of the written instructions of the Engineer. No such deviation from the work described in the tender documents shall be valid unless the same has been specifically confirmed and accepted by the Engineer in writing and incorporated in the Contract.
10.19.2	The Engineer may deviate, either by way of addition or deduction, from the work so described, provided that the Contract sum be not thereby varied on the whole by more than the percentage set out in the tender documents. The value of all additions and deductions shall be added to or deducted from the Contract sum. (Whenever the Engineer intends to exercise such a right his intentions shall specify the deviations which are to be made, the lump-sum assessment or the proposed basis of payment, the extra time allowed, if any, and the date for completion of the entire contract). Any objection by the contractor to any matter concerning the order shall be notified by him in writing to the Engineer within seven days from the date of such order, but under no circumstances shall the work be stopped (unless so ordered by the Engineer) owing to differences or controversy that may arise from such an objection. In the absence of such a notification of objection by the Contractor, he will be deemed to have accepted the order and the conditions stated therein.
10.19.3	Valuation of Deviations shall be as per Clause 2.15 & 2.16 of GCC.
10.20	COMPLIANCE TO REGULATIONS AND BYELAWS
10.20.1	The Contractor shall conform to the provisions of any statute relating to the work and regulations and bylaws of any local authority and of any water and lighting Companies or Undertaking with whose system the work is proposed to be connected. He shall, before making any variation from the drawings or the specifications that may be necessitated for such connections give the Engineer, notice specifying the variation proposed to be made and the reasons therefore and shall not carry out any such variation until he has received instructions from the Engineer in respect thereof. The Contractor shall be bound to give all notices required by statute, regulations or bye-laws as aforesaid and to pay all fees and taxes payable to any authority in respect thereof.
10.20.2	In order to give phillip to Pradhan Mantri Kaushal Vikas Yojna: "The contractor shall, at all stages of work deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/ Industrial Training Institute/ National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/ Central Government. The

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	number of such qualified tradesmen shall not be less than 20% of total skilled/ semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.
10.21	PROGRESS REPORTING :
10.21.1	Contractor is required to draw mutually agreed monthly programme in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed programme and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.
10.21.2	Weekly progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled programme shall be discussed for actions to be taken for achieving targets. The programme for subsequent week shall also be presented by contractor for discussions. The contractor shall constantly update / revise his work programme to meet the overall requirement. All quality problems shall be discussed during above review meetings. Necessary preventive and corrective action, shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of non-conformities.
10.21.3	The contractor shall submit weekly and monthly progress reports, materials reports, consumables (gases / electrodes) report and other reports as per proforma considered necessary by the Engineer.
10.21.4	The progress report shall indicate the progress achieved against planned , with reasons indicating delays , if any, and shall give the remedial actions which the contractor intends to take to make good the slippage or lost time , so that further works again proceed as per the original programme and the slippages do not accumulate and effect the overall programme.
10.21.5	The daily manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
10.22	DRAWING AND DOCUMENTS
10.22.1	The detailed drawings, specifications available with BHEL engineers will form part of this tender specification. These documents will be made available to the contractor

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	during execution of work at site. The contractor will also ensure availability of all drawings / documents at work place.
10.22.2	Necessary drawings / documents by BHEL to carry out the construction work will be furnished to the contractor by BHEL (except those proposed to be prepared by contractor, as mentioned in this contract) on loan which shall be returned to BHEL Engineer at site after completion of work. Contractor shall ensure safe storage and quick retrieval of these documents.
10.22.3	The contractor shall maintain a record of all drawings and documents available with him in a register as per format given by BHEL Engineer. Contractor shall ensure use of pertinent drawings / data / documents and removal of obsolete ones from work place and return to BHEL.
10.22.4	The data furnished in various annexures enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work.
10.22.5	Should any error or ambiguity be discovered in the specification or information the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.
10.22.6	Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimension / details, without specific approval of BHEL.
10.23	Subject package is a critical package hence further extensions for submission of bid may not be given. Bidder is requested to submit their offer within the bid submission date.
10.24	MODIFICATION/ DELETION OF GCC & SCC CLAUSES: A. GCC Clauses: - Clause No. 2.12 of GCC (ORC) shall not be applicable. - Clause No. 2.14.1: of GCC is modified as (The quantities given in the contract are tentative and may change to any extent (both in plus side and minus side). The quoted rates for individual items shall remain firm irrespective of any variations in the individual quantities. No compensation becomes payable in case the variation of the final executed contract value is within the limits of Minus (-) 30% of awarded contract value) B. SCC Clauses: - Clause No. 4.1.4, 4.1.9 & 4.1.10 of SCC (Consumables & Other Items) shall not be applicable. - Clause No. 8.3.2, 8.3.3 and 8.3.4 of SCC (Statutory Inspection of Work) shall not be applicable.

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Chapter-XI: Annexures

Annexure-I: BOQ cum Rate Schedule for the Work of “ALL CIVIL WORKS OF CW PIPES/ CW DUCT AT 2 X 660 MW KHURJA” AT KHURJA, UTTAR PRADESH

Annexure-II: NTPC Safety Rules

UN-PRICE SCHEDULE

ITEM NO.	DESCRIPTION OF WORK	TOTAL VALUE IN INR
1.0	TOTAL PRICE ('A') FOR THE TOTAL WORK AS PER TENDER SPECIFICATION FOR "ALL CIVIL WORKS OF CW PIPES/ CW DUCT AT 2 X 660 MW KHURJA, UTTAR PRADESH"	
Notes:		
a. The rate of individual item for the entire scope of work shall be arrived as per BOQ CUM RATE SCHEDULE (Annexure - I) of TCC of tender. b. The derived item rate will remain firm throughout the contract period.		

Notes:

- i. Bidder's quoted price above shall be complete in all respect for the full scope defined in specification and in accordance with all terms & conditions of tender.
- ii. Contractor shall fully understand description and specifications of items mentioned in BOQ.
- iii. Conditional price bids with any deviation/ clarification etc. are liable to be rejected. No cutting/ erasing/ over writing shall be done.
- iv. Quantities mentioned in rate schedules are approximate only and liable for variation on either side depending upon site/ design requirement.
- v. Taxes (GST) shall be payable extra as per relevant clauses of Technical Conditions of Contract.



BOQ-CUM-RATE SCHEDULE

SCOPE OF WORKS : ALL CIVIL WORKS OF CW PIPES/ CW DUCT AT 2 X 660 MW KHURJA, UTTAR PRADESH

SL.NO.	ITEM NO.	DESCRIPTION	UNIT	QTY	FACTOR	RATE= FACTOR (F) *AMOUNT(A)/100000 (ROUNDED OFF UPTO TWO PLACE OF DECIMAL)	AMOUNT (RS.) = RATE * QUANTITY
	1	Excavation including stacking of excavated material (rock/ soil) required for backfilling away from the excavated pit upto a lead of 1.00 Km., backfilling with selected excavated material (for all lifts) by mechanical means in layers not exceeding 300 mm compact thickness (higher layer thickness upto 500 mm in case of compaction using special type of equipment, such as vibratory roller etc.) to minimum 85 % Standard Proctor Density at optimum moisture content in case of soil and / or to 85 % of original volume in case of boulders and filling the interstices with selected excavated materials, disposal of surplus excavated material at designated location identified by Engineer upto a total lead of 5.00 Kms. (including dressing the top surface) and / or disposal of surplus excavated material by filling within the plant boundary and compacting the same by mechanical means in layers (not exceeding 300 mm thickness, higher layer thickness upto 500 mm in case of compaction using special type of equipment, such as vibratory roller etc.) to minimum 85% Standard Proctor Density at optimum moisture content in case of soil and / or to 85 % of original volume in case of boulders, clearing grass and vegetation, levelling, draining and pumping out surface water (i.e. water other than water below ground water table), lowering of ground water table to maintain dry working conditions till completion of all activities (such as concreting, curing, water proofing, filling / testing etc.), which require dry working conditions providing cofferdams, sheeting, shoring, strutting, bracing, trimming of excavated bottom, testing, with all labour, material, equipment, handling, transportation, preparation of the scheme for excavation and dewatering and getting the same approved, etc., for all types of work, at all levels, all complete, as per specifications, drawings and instructions of the Engineer, including leads as specified above and lifts upto 3.00 M.					
1	1(a)	In soil (All types)	Cu.M.	41000	0.104323		

	2	Excavation including stacking of excavated material (rock / soil) required for backfilling near the excavated pits, backfilling with selected excavated material by pushing and spreading (for all lifts), disposal of surplus excavated material at designated location identified by the Engineer upto a total lead of 5.00 Kms. (including dressing the top surface) and / or disposal of surplus excavated material by filling within the plant boundary and compacting the same by mechanical means in layers not exceeding 300 mm thickness, (higher layer thickness upto 500 mm in case of compaction using special type of equipment, such as vibratory roller etc.) to minimum 85 % Standard Proctor Density at optimum moisture content in case of soil and / or to 85 % of original volume in case of boulders, clearing grass and vegetation, levelling, draining and pumping out surface water (i.e. water other than water below ground water table) lowering of ground water table to maintain dry working conditions till completion of all activities (such as concreting, curing, water proofing, filling / testing etc.), which require dry working conditions providing cofferdams, sheeting, shoring, strutting, bracing, trimming of excavated bottom, testing, with all labour, material, equipment, handling, transportation, preparation of the scheme for excavation and dewatering and getting the same approved, etc., for all types of work, at all levels, all complete, as per specifications, drawings and instructions of the Engineer, including leads as specified above and lifts upto 3.00 M.		0			
2	2(a)	In soil (All types)	Cu.M.	40000	0.103837		
3	2(c)	Extra over item no. 2(a) and 2(b) as applicable, for compacting the backfilled material by watering and ramming to minimum 90% Standard Proctor Density at optimum moisture content in case of soil and / or to 85 % of original volume in case of boulders and filling the interstices with selected excavated materials.	Cu.M.	40000	0.014417		
	3	Extra over item nos. 1 and 2 above as applicable, for all types of excavated material (soil and rock), for additional lifts beyond the initial lift of 3 M (included in items 1 and 2), including maintaining dry working conditions, for the following lifts:					
4	3(a)	Beyond 3.00 M and upto 6.00 M	Cu.M.	35930	0.02627		
5	3(b)	Beyond 6.00 M and up to 9.00 M	Cu.M.	500	0.05254		
6	4(b)	Extra over item no. 1 above, for additional lead of every 1.00Km for stacking of excavated materials (soil/ rock) required for backfilling, away from the excavated pit beyond the initial lead of 1.00 Km.	Cu.M.	30000	0.005746		

	7	Providing and laying nominal mix or design mix, Plain Cement Concrete as specified below, at all levels, for all kinds of works, such as mass concrete, lean concrete, bed blocks, mud-mat, grading, underbed, filling, screed concreting, paving, plinth protection, damp proof course, drains, gully chambers, trenches, etc., with all labour, material, equipment, handling, batching, transporting, pumping, including mix design, mixing (no stacking of material shall be done near the work area where concrete is being placed), conveying, placing and compacting, protecting and curing, testing, for all working conditions, etc., all complete, as per specifications, drawings and instructions of the Engineer. (Cement will be issued by BHEL Free of Cost (FOC) item)					
11	7(a)	M 7.5 (with graded aggregate of nominal size 40mm) nominal mix	Cu.M.	1000	1.88045		
15	7(f)	M 20 (with graded aggregate of nominal size 20mm) nominal mix	Cu.M.	21950	1.868074		
		CONCRETE		0	0		
	8	Providing and laying design mix cement concrete, for Reinforced Cement Concrete works, as specified below, at all levels, for all kinds of works, with 20 mm nominal size graded stone aggregate (unless specified otherwise), with all labour, material, equipment, handling, batching, transporting, testing, pumping, including mix design, admixture, mixing, conveying, placing and compacting, protecting and curing, testing, cleaning and finishing, rendering to give a smooth and even surface, for all working conditions, preparation of scheme for concreting and getting it approved by the Engineer, etc., all complete, as per specifications, drawings and instructions of the Engineer. (Cement will be issued by BHEL Free of Cost (FOC) item)					
	8(a)	For all works below ground level		0	0		
16	8(a)(ii)	M 25	Cu.M.	800	2.05735		
		REINFORCEMENT			0		
	11	Providing and placing reinforcement, as specified below, in reinforced cement concrete and other allied works, at all levels, for all kinds of works (including reinforcement for piling, machine foundations like top decks of TGs, BFPs FANs etc.) with all labour, material, equipment, handling, transportation, cleaning, straightening, cutting, testing, including bending and placing, binding in position, concrete cover blocks, chairs and spacers, laps and anchorage, cover to reinforcement, preparation of bar bending schedules and getting it approved, all complete, as per specifications, drawings and instructions of the Engineer. (Reinforcement steel will be issued by BHEL as Free of Cost (FOC) item)					
	11(a)	For works below ground level			0		

20	11(a)(ii)	High strength deformed TMT bars	M. T.	56	5.342338		
		FORMWORK AND STAGING			0		
	12	Providing and fixing plywood formwork with suitable overlay (film faced), for cast-in-situ, reinforced cement concrete, to give an even and smooth surface to exposed faces of concrete, at all levels and for the works of beams, columns, slab foundations but excluding top deck of machine foundations					
22	12(a)	For works below ground level	Sq.M.	9900	0.287438		
		GROUTING (Cement will be issued by BHEL Free of Cost (FOC) item)			0		
27	18(a)	Providing and laying cement : sand grout (fluid mix and /or plastic mix) for grouting of block-outs, pockets, foundation bolt holes and underside of base plates, with grout consisting of 2 parts by weight of sand, 1 part by weight of cement, blended with, non-metallic anti-shrinkage admixtures in required proportions as specified by manufacturer / Engineer, including all labour, material, equipment, handling, transportation, surface preparation, mixing, placing, curing, testing etc., all complete, as per specifications, drawings and instructions of the Engineer.	CU.DM.	5	0.145944		
28	18(b)	Providing and laying cement aggregate grout (stiff mix) for dry pack application for grouting of underside of base plates, where grout thickness is more than 40 mm, with cement concrete mix (1 : 1.25 : 2) by weight, blended with anti-shrinkage admixtures in required proportions, as specified by manufacturer / Engineer, including all labour, material, equipment, handling, transportation, surface preparation, mixing, placing, curing, testing, etc., all complete, as per specifications, drawings and instructions of the Engineer.	CU.DM.	350	0.137187		
		JOINTS IN CONCRETE			0		
	20	Providing following type of material for joints in concrete, at all levels, including all labour, material, equipment, handling, transportation, testing, cutting, bending, jointing, etc., all complete, as per specifications, drawings and instructions of the Engineer.					
30	20(a)	For expansion joint, PVC water stops of minimum size 225 mm x 6 mm ribbed with central bulb.	R. M.	50	0.240109		
31	20(c)	For construction joints, cement slurry modified with acrylic polymer @ minimum 1.0 litre with every 3 kg. of cement and 1.0 liter of water and applying this slurry on the concrete surface @ 2.0kg./sqm.	Sq.M.	50	0.301617		

	21	Providing and filling in position, sealing compound as specified below, including all labour, material, equipment, handling, transportation, testing, cleaning, mixing, heating, pouring / injecting sealing compound in gaps and joints, at all levels, application of primer, etc., all complete, as per specifications, drawings and instructions of the Engineer.					
32	21(a)	Hot applied bitumen sealing compound, conforming to Grade A of IS : 1834	Kg.	10	0.060324		
33	21(b)	Two part polysulphide gun grade, conforming to IS : 12118	Kg.	10	0.22378		
		DISMANTLING, CHIPPING AND MAKING AN OPENING IN RCC AND PCC					
34	22	Dismantling concrete work (both PCC and RCC of all grades), for all types of structures, at all levels, including all labour, equipment, scaffolding, staging, stacking of serviceable material upto a lead of 500 m and disposal of unserviceable material upto a lead of 2 Km. beyond the plant boundary or as directed by the Engineer, cutting of reinforcement, propping, shoring, enclosures, including all labour, material, equipment, handling, transportation, etc., all complete, as per specifications, drawings and instructions of the Engineer.	CU.M.	0.5	1.183814		
35	23(a)	Chipping of Cement Concrete work (both PCC and RCC), for all type of structures, at all levels, for making grooves, removing surface concrete etc., according to shapes, sizes and profiles as shown on the construction drawings, stacking of serviceable material upto a lead of 500 m, disposal of unserviceable material upto a lead of 2.00 Km. beyond the plant boundary or as directed by the Engineer, cutting of reinforcement, including all labour, equipment, scaffolding, staging, handling, transportation, propping and shoring, enclosures, etc., all complete, as per specifications, drawings and instructions of the Engineer.	CU.DM.	300	0.037683		
36	23(b)	Making of Circular opening of diameter varying from 25 mm to 150 mm and depth upto 450 mm in cement concrete work (both PCC and RCC) of all grades, for all type of structures, at all levels and for all positions, by coring using diamond bits for pockets / thorough opening according to size as shown on the construction drawings, stacking of serviceable material upto a lead of 500 m, disposal of unserviceable material upto a lead of 2.00 Km. beyond the plant boundary or as directed by the Engineer, finishing neatly the surface area of cement concrete exposed after creation of circular opening including all labour, equipment, scaffolding, staging, handling, transportation, propping and shoring, enclosures, etc., all complete, as per specifications, drawings and instructions of the Engineer.	SQ.M.	2	1.342678		

37	23(c)	Making of slit type opening of rectangular, square and or similar shape of varying size (in plan) and depth upto 450 mm in cement concrete work (both PCC and RCC, cutting of reinforcement) of all grades, for all type of structures, at all levels and for all positions, by sawing using wall saw machine with diamond bits, according to size as shown on the construction drawings, locating the reinforcement before making the opening, by use of rebar detector and obtaining specific clearance from the Engineer, if the cutting of the reinforcement bar are involved in the making of the opening, stacking of serviceable material upto a lead of 500 m, disposal of unserviceable material upto a lead of 2.00 Km. beyond the plant boundary or as directed by the Engineer, finishing neatly the surface area of cement concrete exposed after creation of opening including all labour, equipment, scaffolding, staging, handling, transportation, propping and shoring, enclosures, etc., all complete, as per specifications, drawings and instructions of the Engineer.	SQ.M.	2	1.595647		
		PRECAST CEMENT CONCRETE		0	0		
	28	Providing and applying Primer/ Painting system of approved colour and shade to steel surfaces of all types, shapes and sizes, at all levels, to achieve an even shade, including all labour, material, consumables equipment, handling, transportation, protection and cleaning, scaffolding, and staging, testing, etc., all complete, as per specifications, drawings and instructions of the Engineer.					
41	28(a)(i)	Cleaning of steel surfaces in accordance with IS: 1477 (Part-I) by using mechanical power tools and application of chlorinated rubber based Zinc Phosphate primer of minimum 50 micron (DFT) on steel structures to be embedded in concrete (including external surface of CW Duct) including touch up painting for the damaged surfaces of primer.	M. T.	3650	1.556728		

	326	Providing, fabrication, erection, alignment, welding, bolting etc. of structural steel, mild steel, medium and high strength steel at all levels, involving rolled sections, (including rounds), pipes/ rectangular & circular hollow sections including bending to curvature, built-up sections fabricated out of plates and / or rolled sections (including pipes / hollow sections), plates, chequered plates, etc., in columns, beams, crane girders, roof trusses, roof girders, trestles, galleries, purlins, space frames, shear connectors, hangers, struts, monorail beams, stiffeners, wall beams, sheeting runners, brackets, stub columns, bracings, cleats, base plates, splice plates, chequered plate flooring, decking plates, floor plates, seal plates, diaphragms, steel frame grid over false ceiling, walkways, platforms, ladders, stairs, stringers, treads, landings, hand-rails , toe plates, rungs, insert plates, edge protection structures, embedments, lugs, posts, stays, gates, louvers, lacings, stiffeners, gusset plates, washers, bunkers, silos, hoppers, CW liners etc., including design of connections and splicing, preparation and checking of fabrication drawings and getting the same approved, site fabrication, collection of steel, straightening, preparation of cutting plans, cutting, bending and rolling, grinding, clearances, drilling, assembly, bolting, (supply of permanent bolts and nuts to be paid separately under relevant item), erection bolts and nuts (weight not payable), welding, edge preparation, pre-heating, post-heating, sequence of welding, testing of welders, inspection and testing of welds, (visual inspection, non destructive and special testing), rectification / correction of defective welding works, production test plate, erection mark, erection scheme, embedding in concrete, protection against damage in transit, ensuring stability of structures, installation of temporary structures, (weight of temporary structures not payable), setting column bases, etc., with all labour, material, consumables, equipment, handling, transportation, testing (mechanical and non-destructive), etc., and all other activities required for completion of the works, all complete, as per specifications, drawings and instructions of the Engineer.		0			
	326(c)	CW Liners in underground trench with concrete beds and surround or over ground on saddles including additional fitting like pipe pieces upto any diameter, flanges of all types including puddle flanges, bends of all angles and specials like reducers, diffusers, junctions, Tees, Y pieces, manholes with covers, stiffeners, Dish-ends for pipes by cold pressing of plates etc. aligning, packing, strutting, internal bracing, erecting, welding, anchoring, fixing, grouting on saddles, connecting with existing CW liners/duct, welding of metal parts supplied by Engineer, hydro testing and providing 3mm rubber gasket for man-holes conforming to IS 11149. (Excavation, backfilling, concrete, reinforcement, formwork, grouting shall be measured separately under respective items). (PREFABRICATED CW LINERS/DUCT SHALL BE PROVIDED BY BHEL AS A FREE OF COST (FOC) ITEM)					

106	326(c)(i)	900 mm ID to 1800mm ID (including 900mm ID but excluding 1800mm ID)	M.T.	50	8.951186		
107	326(c)(ii)	Diameter ranging from 1800 mm ID to 2800 mm ID	M.T.	960	9.534959		
108	326(c)(iii)	2800 mm ID to 4000mm ID (excluding 2800mm ID but including 4000mm ID)	M.T.	2700	9.924141		
		Total Cost (Rs.)					

NOTE:

1	Bidder's quoted price above shall be complete in all respect for the full scope defined in specification and in accordance with all terms & conditions of tender.
2	Contractor shall fully understand description and Specifications of items mentioned in BOQ.
3	Conditional price bids with any deviation / clarification etc. are liable to be rejected. No cutting / erasing / over writing shall be done.
4	Quantities mentioned in rate schedules are approximate only and liable for variation on either side depending upon site / design requirement. The tentative contract value (CV) of entire scope of work shall be calculated as per finally quoted / accepted rates & the Quantities indicated in BOQ cum Rate Schedule .
5	Contractor's total quoted price as per rate schedule will be taken as tentative only. The contractor undertakes to execute actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out on the basis of quantities actually executed at site and payments will also be regulated for the same.
6	In case of any mis-match in rate and amount on price discrepancy, the same will be dealt as per clause no. 1.4 of GCC.
7	Taxes (GST) shall be payable extra as per relevant clause in Technical Conditions of Contract.

Annexure-II

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NTPC SAFETY RULES

FOR CONSTRUCTION AND ERECTION OF POWER PLANTS

INTRODUCTION:

NTPC Limited is a Maharatna organization taking lead in realizing the power dreams of the Nation with a vision “To be one of the World’s largest and best power utilities, Powering India’s growth”. Safety is one of the prime concerns of NTPC and it always strives towards accident free construction, erection, commissioning, operation and maintenance of its power projects. In this process, NTPC has already formulated Safety policy and guidelines for smooth execution of all its project activities.

In order to strengthen the existing Safety Rules for Construction and Erection and thereby curbing the chances of accidents in Construction & Erection works at various projects of NTPC, the existing safety rules have been revised for strict implementation. These Safety Rules lay down the safety requirements for safe execution of project activities, responsibilities of the contracting agencies, and all concerned involved in Construction and Erection.

A. RESPONSIBILITIES OF CONTRACTORS FOR IMPLEMENTATION OF SAFETY RULES:

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The contractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

FOR GREENFIELD PROJECTS:

- (a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
- (b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

FOR EXPANSION, MODIFICATION, ALTERATION AND, OR CONSTRUCTION ACTIVITY WITHIN AN EXISTING PLANT OPERATING AS PER APPROVED SITE PLAN UNDER THE FACTORIES ACT;

- (a) Factories Act, 1948,
- (b) Factories Rules, as adopted by the various State Governments
- (c) BOCW Act
- (d) BOCW Rules

The contractor is also required to ensure compliance with all the relevant Acts/Rules in addition to above.

It shall be incumbent on the contractor to ensure that the requirements of safety, statutory or otherwise specified, are fully met. Thus the onus of implementation of the norms so prescribed shall squarely rest with the contractor concerned or, on his behalf, his sub-contractor or any other agency deployed by him, indemnifying NTPC from all the liabilities that may arise out of any failure to comply with the above mentioned Acts/Rules or any contravention thereof by the contractor or any other sub-agency on his behalf.

Safety cannot be ensured solely through Rules and Regulations or Codes. It is the responsibility of the Contracting Agency to ensure that basic safety principles are incorporated in the planning stage of their mobilization, execution, installation of machines, equipment, storage, etc., and initiate and maintain *safety programs*. It is desirable to have a planned programme and secure adequate cooperation of senior management, EICs, sub-contracting agencies, supervisory personnel and workers involved to ensure the implementation of the provisions of these Rules in true spirit so as to achieve the ultimate goal of *accident prevention*.

It shall also be the responsibility of the contracting agency to provide amenities and safety requirements on each construction job in order to reduce or to eliminate hazards of construction activities and also to provide necessary *first aid* facilities as well as Ambulance van (in case of major agencies) for prompt transportation of injured persons to a physician or hospital.

It is also mandated that the authorized representative of NTPC, namely, the Engineer-in-charge, may, at his convenience, exercise such superintendence, supervision and, or control as may be deemed necessary, but this shall not absolve the contractor of his basic responsibility for strict compliance with the norms, standards and, or legal provisions as applicable under the Factories Act/Rules and the Building and other construction (regulation of employment and conditions of service) Act/Rules.

Section wise checklist of provisions of BOCW Act/Rules is given hereunder for ready reference of the contractor. (This list has been prepared in chronological order with primary importance to Section of Act and secondary importance to Rules)

S - Refers relevant Sections in BOCWA

R - Refers relevant Rules in BOCWR

Sl. No.	ITEMS	RELEVANT SECTIONS / RULES IN BOCWA AND BOCWR AND RBOCWR
1	Registration of establishment	S – 7, R – 23 to 27
2.	Display of registration certification at workplace	R – 26 (5)
3.	Hours of work	S – 28 R – 234 to 237
4.	Register of overtime	S – 28; S – 29 R – 241(1) Form XXII
5.	Weekly rest and payment at rest	R – 235
6.	Night shift	R – 236
7.	Maintenance of workers registers and records	S – 30 R – 238
8.	Notice of commencement and completion	S – 46 R – 239
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a); Form XVI and XVII
11.	Payment of wages	R – 248
12.	Display of notice of wages regarding	R – 249
13.	Register of damage or loss	R – 241(1)(a); Form XIX, XX, XXI
14.	Issue of wages book	R – 241(2)(a); Form XXIII
15.	Service certificate for each workers	R – 241(2)(b); Form XXIV
16.	Display an abstract of BOCWA and BOCWR	R – 241(5)
17.	Annual return	R – 242; Form XXV
18.	Drinking water	S – 32
19.	Latrines and Urinals	S – 33 R - 243
20.	Accommodation	S – 34
21.	Creches	S – 35
22.	First-aid boxes	S – 36 R – 231 and Schedule III
23.	Canteens	S – 37 R – 244
24.	Food stuff and other items served in the canteens	R – 245
25.	Supply of tea and snacks in work place	R – 246
26.	Food charges on no loss no profit basis	R - 247
27.	Delhi BOCW welfare Board Rules	R – 250 to 296
28.	Safety committee	S – 38 R – 208

29.	Safety officer	S – 38 R – 209 and Schedule VII
30.	Reporting of accidents and dangerous occurrences	S – 39,R – 210
31.	Procedure for inquiry in to the causes of accidents	R – 211
32.	Responsibility of employer	S - 44 R – 5
33.	Responsibility of Architects, Project engineer and Designers	R – 6
34.	Responsibility of workmen	R – 8
35.	Responsibility for payment of wages and compensation	S – 45
36.	Penalties and Procedures	S – 47; S – 55
37.	Excessive noise, vibration etc.	R – 34
38.	Fire Protection	R – 35
39.	Emergency action plan	R – 36
40.	Fencing of motors	R – 37
41.	Lifting of carrying of excessive weight	R – 38
42.	Health, Safety and Environmental Policy	R – 39
43.	Dangerous and Harmful Environment	R – 40
44.	Overhead protection	R – 41
45.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
46.	Dust, Gases, Fumes, etc.	R – 43
47.	Corrosive substance	R – 49
48.	Eye Protection	R – 45
49.	Head Protection and other protection apparel	R – 46; R – 54
50.	Electrical Hazards	R – 47
51.	Vehicular traffic	R – 48
52.	Stability of structure	R – 49
53.	Illumination	R – 50; R – 124
54.	Stacking of materials	R – 51
55.	Disposal of debris	R – 52
56.	Numbering and marking of floors	R – 53
57.	Lifting appliances and gears	R – 55 to 81
58.	Runways and Ramps	R – 82 to 85
59.	Working on or adjacent to water	R – 86 & 87

60.	Transport and earthmoving equipment's	R – 88 to 95
61.	Concrete work	R – 96 to 107
62.	Demolition	R – 108 to 118
63.	Excavation and Tunneling works	R – 119 to 168
64.	Ventilation	R – 153
65.	Construction, repair and maintenance of step roof	R – 169 to 171
66.	Ladders and Step ladders	R – 172 to 174
67.	Catch platform and hoardings, chutes, safety belts and nets	R – 175 to 180
68.	Structural frame and formworks	R – 181 to 185
69.	Stacking and unstacking	R – 186 & 187
70.	Scaffold	R – 188 to 205
71.	Cofferdams and Caissons	R – 206 to 211
72.	Explosives	R – 212 & 213
73.	Piling	R – 214 to 222
74.	Medical Examination for building and other construction worker, Crane operator an Transport vehicle drivers	R – 81; R – 223(a)(iii) and Schedule
75.	Medical examination for occupational health hazards	R – 233(a)(iv)
76.	Charging of workers for Medical Examination	R – 223(b)
77.	Occupational health centres and Medical officers	R – 225 and Schedule X & XI
78.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
79.	Stretchers	R – 228
80.	Occupational health service for building workers	R – 229
81.	Medical examination for occupational health hazards	R – 223(a)(iv)
82.	Emergency care services and emergency treatment	R – 232
83.	Panel of experts and agencies	Central Rule 250
84.	Power of inspectors	Central rule 251

B. RESPONSIBILITIES AND DUTIES OF WORKERS

- (a) It shall be the responsibility of the worker to comply with the requirements of safety as laid down for him and the group of workers to which he belongs and fully cooperate in the discharge of the responsibility that has been assigned to the contractor.
- (b) If he discovers any defects in the lifting appliance, lifting gear, lifting device or those concerning any transport equipment or other construction equipment or tools as well as the physical work conditions, he will report such defects promptly to his employer or NTPC Engineer or other person in authority;
- (c) No building worker shall, unless duly authorized or in case of absolute necessity, remove or interfere with any fencing, guards, gangways, gear, ladder, hatch covering, life saving appliances, lighting or other things whatsoever required and provided for safety and health. If any of the aforesaid things is removed, the persons engaged in the work shall restore such thing at the end of the period during which its removal was necessary;
- (d) Every worker shall use only means of access provided in accordance with the approved norms and no person shall authorize or order another to use such means of access or method other than those approved;
- (e) Workers shall use such means of access and egress for going to and exiting from the workplace as provided.

SECTION - I

SAFETY MANAGEMENT

1.0 SAFETY MANUAL AND SAFETY POLICY:

- 1.1** The Safety policy of the contracting agency should reflect the commitment of the concerned agency towards safety and health of the workers specified for the particular site.
- 1.2** The Contractor shall have Safety Plan detailing the safety norms evolved through Safety Policy and Job Safety Analysis (JSA) or Hazard Identification & Risk Assessment (HIRA) of all package activities and constitute a Safety management program. Contracts shall also ensure POWRA (point of work risk assessment) before start of any activity.
- 1.3** The safety management programme in the form of Safety Manual shall give details of provisions proposed by the agency w.r.t. Job Safety Analysis (JSA) or Hazard Identification and Risk Assessment (HIRA) to ensure safety of the employees and elimination of health hazards. The Safety Manual including safety policy duly signed by the head/senior executive of the agency shall be submitted to the concerned Engineer-Incharge(EIC), NTPC before start of their project activities at site.
- 1.4** Each contracting agency shall have facilities for conducting the above safety management programme, commensurate with magnitude of the work under contract.

2.0 APPOINTMENT OF SAFETY OFFICER/SAFETY SUPERVISOR:

- 2.1** Each contracting Agency shall provide a sufficient number of qualified, suitable and experienced persons to manage all safety related matter on Site relating to the works. Irrespective of manpower employed by the agency whether temporary, casual, probationer, regular or permanent or on contract, Agency shall deploy a qualified Safety Officer/executive, responsible for carrying out the safety management programme before start of the work.
- 2.2** The safety officer shall create an organization, commensurate with the project activities, consisting of other staff as required for suitable deployment.
- 2.3** The schedule of requirement of safety personnel is given below.

No. of Workers	No. of Safety Supervisors	No. of Safety Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5
Above 4000	18 + One additional supervisor up to every additional 250 workers	5 + one safety officer up to addition 1000 workers

2.4 The qualification and experience of the safety personnel should meet the following criteria.

- a) Safety Supervisor: (i) Possesses recognized degree in any branch of Engineering. OR
(ii) Diploma in any branch of Engineering with at least one year construction experience.
- b) Safety Officer/Safety Executive: Qualification as given under BOCW Act/rules and minimum experience of three years.

2.5 In case contractor fails to employ the required safety professionals, the department may at the cost and risk of the contractor deploy additional/required safety professionals. The cost incurred towards this shall be deducted from contractor's bill at following the rates or actual whichever is higher.

- 1. Safety Engineer Rs. 1500/day.
- 2. Safety Supervisor Rs. 1000/day.

3.0 MEETING FOR SAFETY AFTER AWARD OF THE CONTRACT:

Representatives of contracting agency along with safety Officer/executive shall meet the concerned EIC of the particular activity prior to start of construction activities for the purpose of discussing safety standards and requirements applicable to the work under contract. The person representing the agency should be a responsible person for all their site activities.

4.0 PERSONAL PROTECTIVE EQUIPMENT:

4.1 The contracting agency should ensure sufficient inventory of personal protective equipment (PPEs) prior to initial mobilization as specified in the Bidding Documents. After identifying the need of the required PPEs for various activities performed at the site, an additional inventory of approx. 20% of required PPEs should be maintain during the execution of the work. A PPE plan shall be prepared which gives fair idea regarding issue of PPEs to various personnel as per the following 'PPE Selection Matrix'.

4.2 Mandatory PPEs: Wearing of Safety Helmet, Safety Shoes and reflective jacket is mandatory for all work at site and it should be ensured that all employees and project visiting personnel shall invariably wear safety helmet, safety shoes & reflective jacket.

PPE Matrix (apart from mandatory PPEs, i.e., Safety Helmet & Safety Shoes)

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space

Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLFBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	
Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/ EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA : Online breathing apparatus

4.3 The above-mentioned PPEs should be made available with contractor at site and issued to the concerned workers on the day of employment. All PPEs shall comply with ISI standards with valid test certificates.

4.4 At least two breathing apparatus sets (complying requirement as per IS: 10245) shall be provided at each site where excavation/tunneling works and Welding/ Cutting operations in confined areas are being carried out, to rescue the victims under exposure to harmful gases/vapors, if any.

5.0 SAFETY COMMITTEE:

- 5.1** *Safety committee* shall be formed within each contracting agency comprising of worker representatives with equal no. of management representatives as per the provisions of BOCW Act/rules. This committee in each agency shall meet at least once in every month. The safety officer of the concerned agency shall coordinate these meetings. NTPC Safety officer shall be special invitee for Safety Committee meetings. The safety committee functioning shall be in line with the provisions of BOCW Act/Rules.
- 5.2** Apart from the above, each agency shall organize safety meetings every day before start of day's work to educate & motivate the workers about the necessity of safety. Case study of accident/ incident can be shared in these meetings.
- 5.3** The contractor shall also regularly organize safety meetings for all job supervisors/foremen.
- 5.4** Weekly meeting with agencies' Safety Officers to be organized by safety department of NTPC and minutes to be recorded, circulated and compliance status to be checked on regular basis.

6.0 SAFETY MESSAGE PROPAGATION:

- 6.1** Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely. Minimum one safety message board/hoarding of appropriate size for every 10 workers to be provided and maintained by the concerned agency.
- 6.2** Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
- 6.3** Safety suggestion boxes shall be kept at each contractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.

7. COMPETENCY OF EMPLOYEES:

- 7.1** Throughout the course of the contract, persons employed by agency shall be physically fit, qualified/experienced to perform their assigned duties/ jobs.
- 7.2** Employees shall not, knowingly be permitted to work in a manner that their ability or alertness is so impaired because of fatigue, illness or any other reason, that it may expose them and or others to injury.
- 7.3** No worker, vehicle operator shall be less than 18 years of age. And the vehicle operator shall have a valid license as per requirements of Motor Vehicle Act.
- 7.4** Contractor shall comply with all applicable state/central laws and codes related to employment of operators for Hoist, Shovel, Crane, Tractor, Bull-dozer, any other howling heavy equipment/vehicle.

8.0 SAFETY INDUCTION AND TRAINING :

- 8.1** Each worker deployed by the agency shall be given 2-days induction training which shall include the medical examination and instructions related to particular job, fire fighting, first-aid and reporting of accidents. All employees shall be given safety training as per BOCW Act/Rules.
- 8.2** The contracting agency shall also impart job specific skill based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge.

TRAINING MATRIX:

Name of topic	Executives	Super visors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y
Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=Yes

9.0 ID PASS

- 9.1** CLIMS (Contract Labor Information Management System) will be the criterion for entering or gate pass system if implemented at site.
- 9.2** The contractor shall ensure that all personnel working at site having a photo Identity card before they are engaged for any work and properly mentioned details like validity, Category/designation and work area etc. This ID card should be issued only after ensuring their screening test, medical fitness and safety induction training. Id card gate pass shall be indicated with 3 nos. of offence marks. With each offence the gate pass of concerned workmen/ supervisor will be punched giving on the spot indication of persons indulging in unsafe actions.
- 9.3** Drinking of Alcoholic beverages is strictly prohibited. Employees under the influence of any intoxicants, even to the slightest degree, shall not be permitted to remain at work. Each contractor should maintain 'breath analyzer' to determine the intoxicated workers at site.

10 SAFETY AUDIT

- 10.1** Internal Safety Audit once in every six months by the contracting agency and external safety audit as once in a year by third party shall be conducted, with prior intimation to EIC and NTPC Safety Deptt. The external auditing agency should be reputed safety institution or a certified Safety Auditor under any statutory legislation. The audit report along with time bound action plan should be submitted to Engineer-in-charge and NTPC Safety Dept.
- 10.2** Apart from above, Electrical Safety Audit shall be conducted quarterly by a team comprising of Electrical engineer, Safety representative of contractor and NTPC Electrical Erection representative covering the following and submit the report to EIC.
- i) Electrical incidents investigation findings and remedial measures implemented.
 - ii) Adequacy of power supply requirements
 - iii) Power distribution system in place
 - iv) Updated electrical single line diagram including the IP44 DBs arrangement.
 - v) Electrical protection devices – ELCBs, O/L protections etc.
 - vi) Earth or ground connection and earth pit maintenance details
 - vii) Education and training of electrical personnel undertaken
 - viii) Any other point appropriate to the site conditions.

11. SAFETY BUDGET

Every contracting agency should clearly estimate and allocate a separate budget head for safety requirements every year and make the safety activity plan for the year and submit to NTPC EIC & Head of Safety. Budget allocations should be practically adequate to the site safety requirements and the details shall be intimated to the concerned EIC and safety deptt. before start of the work under the contract and subsequently, every year by 15th of April. Engineer-in Charge in consultation with Head of Safety shall review and monitor the effective utilization of allocated budget for safety related activities by the Contractor.

12. REPORTING AND INVESTIGATION OF ACCIDENTS AND DANGEROUS OCCURRENCES:

12.1 Reporting of accidents: Notice of any accident (the prescribed format is annexed to the manual) to a worker at the building or construction site that

- (a) Causes loss of life; or
- (b) Disables a worker from working for a period of **48 hours** or more immediately following the accident;

Shall forthwith be sent by Telegram, Telephone, Fax, Email or similar other means including special Messenger within **four hours** in case of **fatal accidents** and **72 hours** in case of **other accidents**, besides the Engineer-in-charge, to:

- I. The Regional Labour Commissioner (Central);
- II. The Board with which the worker involved was registered as a beneficiary;
- III. Director General of Building and other construction (regulation of employment and conditions of service) Act/Rules; and
- IV. The next of kin or other relative of the worker involved in the accident;

12.2 Further, notice of accident shall be sent in respect of an accident which

- (a) Causes loss of life; or
- (b) Disables the injured worker from work for more than 10 days to
 - (1) The Officer-in-charge of the nearest Police Station;
 - (2) The District Magistrate or, if the District Magistrate by order so desires, to
 - (3) The Sub-Divisional Magistrate;

12.3 Where any accident causing **disablement that subsequently results in death**, notice thereof in writing of such death, shall be sent the Authorities mentioned above within **72 hours** of such death.

12.4 In case of an accident causing minor injury, first-aid shall be administered and that resulting in disability of **48 hours or more**, the injured worker shall be given first-aid and immediately transferred to a Hospital or other place for medical treatment.

12.5 All near-miss accidents shall be reported to NTPC Engineer In-charge and Safety Officer as per prescribed format.

12.6 Reporting of dangerous occurrences: The following classes of dangerous occurrences shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker, namely:

- (a) Collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;
- (b) Falling of objects from height;
- (c) Collapse or subsidence of soil, any wall, floor, gallery, roof or any other part of any structure, platform, staging, scaffolding or means of access including formwork;
- (d) Contract work, excavation, collapse of transmission;
- (e) Explosion of receiver or vessel used for storage at a pressure than atmospheric pressure, of any gases or any liquid or solid used as building material;

- (f) Fire and explosion causing damage to any place on construction site where building workers are employed;
- (g) Spillage or leakage of any hazardous substance and damage to their container;
- (h) Collapse, capsizing, toppling or collision of transport equipment;
- (i) Leakage or release of harmful toxic gases at the construction site;
- (j) In case of failure of a lifting appliance, loose gear, hoist or building and other construction work, machinery and transport equipment at a construction site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Authorities;

12.7 Every notice given for fatal accidents shall be followed by a written report to the concerned Statutory Authorities and the Engineer In-charge in the specified Form annexed as Schedule, under acknowledgement.

12.8 Incident / injury statistics shall be maintained by all agencies cause wise.

12.9 Investigation of accidents and dangerous occurrences

Besides reporting, it shall be the responsibility of the contractor to constitute a team (members as per the gravity of the incident) of responsible person to thoroughly investigate all incidents involving near-miss accidents, lost-time and reportable accidents and dangerous occurrences with a view to finding out the causative factor, taking remedial measures and fixing responsibility, and make a copy of the investigation report along with action-plan, specifying a definite time-frame for implementation of the findings, available to the Engineer in-charge forthwith.

13. MEDICAL AND FIRST AID AMENITIES:

13.1 It is the responsibility of each contracting agency to ensure the availability of suitable arrangements at their work site for rendering prompt and efficient First aid to injured persons.

13.2 Arrange one trained and certified first aid for every twenty workers in each shift.

13.3 Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital shall be provided before start of the work in cases where 500 or more than 500 workers are employed. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Agency for providing Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital in case of an Accident / Emergency. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

13.4 Deploy one full time construction medical officer (qualification as per Schedule XI of BOCW Central Rules -1998) for cases where 500 or more workers are employed (upto one thousand workers) and one additional construction medical officer for additional one thousand workers or part thereof. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Hospital / Nursing home in the vicinity of the

Project/Site where work is being executed, for providing adequate medical treatment by qualified medical officers and nursing staff, as and when required. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

Notwithstanding anything stated above, Contractor/Agency shall strictly comply with the requirements of relevant BOCW Act/ BOCW Rules/ Factory Act/Factory Rules/ any other statutory Act/Rules/Law with regards to providing suitable medical facilities to the workers.

In case contractor fails to employ the required construction medical officer alongwith Additional staff, corresponding payment for the same shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

- 13.5** Additional staff including one nurse, one dresser-cum compounder, one sweeper-cum-ward boy with each construction medical officer for full working hours
- 13.6** The Telephone nos. of Medical officer, Hospital(s) or ambulance shall also be conspicuously displayed at each work site.
- 13.7** First-aid kits as approved by medical officer shall be provided at accessible points in the ratio of at least one kit for every 50 employees.
- 13.8 Health Management:** The site manager shall implement health examinations for the working personnel on a regular basis.

Types of health examination	Target	Frequency
General health examination	All workers	Annual
Occupational health examination (Audiometric, PFT, Vision etc.)	Worker engaging in noise, dust, vibration, harmful light generating work	Annual
Occupational health examination (Vision)	Personnel involved in operation of Cranes, heavy vehicles	Annual
Occupational health examination (Vertigo/Height pass)	Workers engaged at Height Works	At the time of induction training and every year

14. TESTING & EXAMINATION OF LIFTING, TOOLS, TACKLES, PRESSURE VESSELS AND OTHER EQUIPMENT:

- 14.1** All the lifting equipment, tools, tackles, pressure vessels etc. shall be tested & examined as per BOCW or Factories Act and rules made there under.

- 14.2** The records & certificates of such testing & examination shall be maintained and readily available for reference to statutory authorities/engineer-in-charge.
- 14.3** Proper color coding system should be maintained and marking should be done accordingly on all lifting tackles.
- 14.4** Regular testing of ELCBs and RCCBs by competent electrician must be ensured by agencies and record should be maintained.

15. EMERGENCY MANAGEMENT PLAN

- 15.1** The contractor shall ensure that an Emergency Management Plan is prepared to deal with emergencies arising out of:
 - a. Fire and explosion;
 - b. Collapse of lifting appliances and transport equipment;
 - c. Collapse of building, sheds or structure etc.;
 - d. Gas leakage or spillage of dangerous goods or chemicals;
 - e. Drowning of workers, sinking vessels, and
 - f. Landslides getting workers buried; floods, storms and other natural calamities.
- 15.2** While arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.
- 15.3** It is also required that there is a tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.
- 15.4** It shall be the responsibility of the contractor to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to NTPC, telephonically initially and followed by a written report, shall be made by the contractor.

16. ENFORCEMENT OF SAFETY CODE, SAFETY RULES & REGULATIONS:

The Engineer-In charge shall ensure that the contractor is exercising at all times, reasonable and proper precautions for the safety of people at works and complying with the provisions of current safety rules and laws according to safety code and relevant statutes of state/central governments. In case of negligence or default, the agency shall be penalized suitably as per penal provisions of NTPC Safety Rules.

17. WORK PERMIT SYSTEM

- 17.1** The Contractor shall implement Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction activities. They start the work

only after safe procedures have been defined and clearance taken from respective NTPC EICs. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

17.2 Examples of high-risk activities include but are not limited to:

- i) Entry into confined spaces
- ii) Cutting & welding
- iii) Working at Height along with checklist iv) Working on electrical equipment
- v) Heavy lifting operations
- vi) Removal of grating/ Handrail / floor opening
- vii) Material Shifting

The copies of recommended formats for reference is given in annexure-IV.

17.3 The permit-to-work system should be fully documented, laying down:

- i) How the system works
- ii) The jobs it is to be used for;
- iii) The responsibilities and training of those involved; and
- iv) How to check its operation;

17.4 A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours.

17.5 A copy of each Permit to Work (PTW) shall be displayed near to work are (on PTW Display board) in close proximity to the actual works location to which it applies.

18. ACCESS TO AND FROM THE WORKPLACE

18.1 Safe, clean, well lit, unencumbered access and egress to and from work areas shall be maintained at all times in normal operating conditions.

18.2 The number and location of accesses and egresses from and to the workplace shall be adapted to the number of people likely to be present at any time, and therefore to evacuate from the workplace in case of emergency.

18.3 If access and egress to work areas are restricted due to operational conditions (e.g. access restricted due to pressure testing, etc.), alternative access and egress ways must be implemented, so far as is reasonably practicable. If this is not reasonably practicable, all concerned organizations and persons must be informed of the access restrictions, and work scheduling must be adapted in consequence.

18.4 Temporary access to height or into ground openings shall be of purpose made material such as scaffolds, stair cases/towers and ramps, which incorporate guardrails .

19. INTERFERENCE WITH MOVING VEHICLES AND PEDESTRIANS

- 19.1** The circulation of vehicles and pedestrians must be segregated by establishing restricted areas, one way routes where possible, pedestrian crossing zones and designated parking areas.
- 19.2** The appropriate measures must be implemented in order to prevent collision between pedestrians and vehicles at pedestrian crossings. This may include, but shall not be limited to:
- Mirrors;
 - Lighting;
 - Speed bumps before the crossing point.
- 19.3** Vehicle and pedestrian ways shall be physically separated with Hard-barriers, so far as is reasonably practicable, and be indicated with signs.



- 19.4** When it is not reasonably practical to implement a physical segregation, pedestrians must maintain safety distance of at least 2 meters from moving/operating vehicles at all times.
- 19.5** Traffic rules must be made visible through signage and traffic stops, consistent with those used on public
- 19.6** Roads as per road safety requirement.
- 19.7** All pedestrians on Project sites must wear high-visibility garments.
- 19.8** Pedestrians (including banksmen) must wear high-visibility garments in all areas where trucks and other vehicles (forklifts, cranes, etc.) maneuver. These areas must be clearly signaled / marked (floor painting, Hard-barriers, signs, etc.). Additional points:
- 19.9** Competent banksmen must be used for operations involving reversing or maneuvering where space or view is restricted.
- 19.10** Drivers must only operate vehicles they are competent to drive and must follow the established traffic routes and comply with all site rules.
- 19.11** The maximum driving speed on site is 15 km per hour.
- 19.12** Drivers and passengers must not get on or off moving vehicles.
- 19.13** When driving a forklift, forks must be lowered, the mast tilted back.
- 19.14** Smoking, eating, drinking, using a mobile phone or using earbuds or headphones when driving a vehicle is strictly prohibited.
- 19.15** When the vehicle is not in use, it must be ensured that:
- The engine is stopped and prevented from unauthorized use (e.g.: starter key removed), brake applied (and with wheels chocked for heavy vehicles);
 - All raised parts are lowered to the ground or put in a safe position (cranes);
 - It does not obstruct emergency exits, other routes, fire equipment or electricity panels.

20. HOUSEKEEPING

The contractor shall ensure that their work area is kept clean, tidy and free from debris generated by their activities. All debris/scrap should be stored in separate bins. The work areas must be cleaned on a daily basis and a full cleaning session of each area shall be conducted on a weekly basis. All equipment, materials and vehicles shall be stored in an orderly manner. Access to emergency equipment, exits, telephones, safety showers, eye wash stations, fire extinguishers, pull boxes, fire hoses, etc. shall not be blocked or otherwise disturbed, restricted or delayed.

21. STACKING AND STORAGE PRACTICE

Contractor Agency shall ensure stacked material is bonded on a stable and level footing capable of carrying the mass of the stack. Adequate clearances shall be provided between the sides of the stack and top to facilitate unimpeded access to service equipment like overhead wiring, cranes, forklifts and firefighting equipment, and hoses. Circular items shall be sufficiently choked with wedges not with odd bits of materials. Free-standing stacks of gunny bags and sacks such as Cement bags shall be stacked to prescribe safe stacking heights with layers formed for stable bonding, preventing slippage causing accidents. Stacking against walls shall not be permissible.

Contractor shall maintain the premises and surrounding areas in clean and clear manner with safe access and egress. There shall be sufficient and adequate storage racks, shelving, bins and pallets and material handling equipment to stack his construction materials such as Pipes, Structural and his construction enabling materials. Unwanted materials shall be promptly moved away for efficient material movement.

Any temporary store shed will be built in conformity with fire safety requirements. The stores must be provided with adequate lighting arrangement (Flame proof / intrinsically safe depending upon the Zone category) and must be equipped with sufficient fire extinguishing arrangement. "No Smoking" and other relevant signage must be displayed conspicuously at strategic locations and safety precautions must be strictly enforced.

All material should be kept at least 150mm above from the ground by providing wooden packing below. Maximum height of material stacking should not be greater than 3 meter. All loose material must be kept in wooden box or in sharp edge protected drum and material identification details to be displayed. Materials inside store room should be kept on scaffold rack.

Gas cylinder storage area must be 30m away from the hot work zone and separate storage facility must be available for empty and full cylinder with proper shed. Storage area must be design in a way that 6 meter distance between LPG/DA and oxygen maintained

22. CONFINED SPACES

All Confined Spaces belonging to Subcontractor shall be identified and clearly signed posted as a confined space forbidden to unauthorized Personnel at every entrance. A method for preventing entry must be established and maintained for all Confined Spaces. Physical prevention system (such as locks) is preferred.

Before commencing work in a Confined Space, the Subcontractor must obtain a Permit to Work from the relevant authority.

The following requirements shall be met at any time:

- Only competent and trained workers can participate to work in confined spaces (as a minimum as per local Law). A Confined Space Entry Log (or equivalent) must be used to identify the person inside the Confined Space at any time;
- Air Analysis tests must be carried out to determine if the Confined Space is oxygen deficient and/or contains flammable substances, toxic agents, carbon monoxide and/or harmful physical agents. The air shall be analyzed before starting work, during work and after work. Adequate ventilation must be provided;
- Working in the confined space without a watcher is strictly forbidden. An adequate means of communication is required and shall enable easy and clear communication:
 - Between those inside the space,
 - Between those inside the space and those outside,
 - To summon help in case of emergency;
 - Adequate emergency provisions must be in place. In particular, necessary rescue equipment must be ready, pre inspected and available. The arrangements need to be suitable and sufficient for the rescue of persons in the event of an emergency.

23. FIRE PROTECTION AND PREVENTION

Routine hot works should be described in the contractor Risk Control Plan .Non-routine hot works are submitted to daily hot works permits given by the relevant authority.

Full and unrestricted access to emergency exits, fire-fighting equipment, fire control and emergency vehicles shall be maintained at all times. The Subcontractor shall provide, install and maintain their own temporary fire protection against hazards they introduce to the Site (work areas, storage areas, and temporary facilities under their responsibilities).

Fire extinguishers shall be inspected at least annually by a certified person and visually inspected monthly and documented by the Contractor.

24. ELECTRICAL SAFETY

Personal authorization must be issued by Contractor Management (or formally designed delegates) likely to perform or supervise electrical works.

Without such an authorization validated by EIC, no Contractor's employee shall undertake electrical works.

No live work on high voltage or medium voltage is allowed. All high voltage and medium voltage electrical works must be performed on isolated equipment and only after verification of absence of voltage with suitable equipment. Low voltage and very low voltage live work is only allowed for measurement tests and checks of equipment. The below measures will be taken:

- Work practices must protect against direct or indirect body contact by means of tools or materials and be suitable for work conditions and the exposed voltage level
- A Lockout and Tagout procedure must be applied prior to commencing any electrical work. Prior to commencing works on isolated equipment, a verification of absence of voltage with suitable safety test equipment must be performed.
- Energized panels will remain locked with a specific key or tool whenever they are unattended and tagged with the signs and warnings indicating the presence of danger. If not reasonably practicable, a restricted area delimited with physical barriers and supported by warning signs must be implemented around the opened equipment.
- Only qualified electrical Contractor Personnel may enter substations and/or transformer vaults and only after being specifically authorized by NTPC EIC.
- All joints (Both terminal and intermediate) in cable should be made using lugs and joint area should be crimped using crimping tools.
- All temporary connection should be provided through 30mA ELCB/RCCB using 3 core double insulated cable and only 3 pin industrial plug top will be used for connection.
- Zero energy verification needs to be ensured before any electrical operation using only VAV before working on a live circuit which has been isolated
- Only industrial type DB to be used for connection and weather protection shed needs to be provided for every DB and shed height should not be less than man height.
- Double earthing protection must be provided for every electrical equipment and earthing value should be less than 1 Ohm
- Deployment of trained, experienced & licensed electrician as well as licensed electrical supervisor must be ensured at site as per Rule-45 of the Indian Electricity Rules, 1956 ;
- EIC May perform screening/ competency test for all contractor electrical professions i.e. electrical engineers and helpers. Selection/ rejection of the personnel who appear for the screening is sole discretion of EIC
- Electrical helper who will be engaged in helping the electrician/ engineer must have minimum ITI certificate to be eligible for working with him
- All PPE's used while being involved in electrical work must be as per IS Standards available for electrical work

25. COMPRESSED GAS CYLINDERS

Gas cylinders shall be securely stored and transported, and identified and used in line with the safety Requirements as per Gas Cylinder Rules -2106.

Hose lines shall be adequately protected, inspected and tested for leaks in line with the safety Requirements. Flash back arrestor /NRV must be used at both ends of the hoses and all hose should be free from damage and fixed properly preferably using crimping clamps. Leakage test must be done before every use by soap solution and physical inspection of hose must be carried out regularly. Only trolley attached with wheel will be used for cylinder transportation in which cylinders must be kept secured with chain. Only Industrial type regulator fitted with two stage double dial pressure gauge is allowed to be used.

26. LIFTING OPERATIONS

The Contractor shall prepare a lifting plan, checked and submit for authorization by contractor's competent authorized persons prior to any lifting operation and formally communicated to all persons undertaking the work.

All persons preparing, issuing lifting plans and all persons involved in lifting operations must be subject to formal competence checks by the contractor to ensure necessary training, experience and qualification prior to commencing work. The Subcontractor must ensure that their nominated Lifting Leader has appropriate qualifications.

Contractor lifting plans include:

The lifting methodology, step by step

The risk analysis of the operation including consideration for weather conditions and work environments (e.g.: proximity of hazards and obstructions to the load, consideration for overturning, load integrity) where appropriate and consideration for simultaneous operations and the measures taken to avoid conflicting tasks in the lifting area

The identification of the designated lifting area, the fall zone and the control measures to prevent access such as barriers, signs, etc.

The description of the type, weight, size, shape and center of gravity of the load and the method used for slinging, attaching and detaching the load with the availability of approved lifting points on load when necessary

The list of the certified and inspected equipment and lifting accessories to be used

The composition of the team required to perform the task (crane driver, rigger, etc.) with the needed qualifications and description of their roles and responsibilities including the intended communication method

Any Heavy equipment (crane, winch machine, etc.) manufactured less than 15 years from the current year shall be only allowed to be used at our project Site's. Pre-safety Inspection of the equipment by safety deptt. shall be done before mobilizing the equipment at our project site.

The contractor must ensure that a competent operational leader is formally appointed to supervise each lifting operation. All lifting plans must clearly define the specific roles and responsibilities for each person involved (e.g.: crane drivers, lifting coordinators and riggers) and must be checked and issued prior to lifting operation. Clear communication channels must be formally established and maintained between everyone involved in a lift with only authorized person giving instruction to the operator.

Special permission needs to be taken from NTPC EIC for tandem lifting and for any non-routine lifting operations must strictly adhere to the guidelines described in corresponding Standard / Procedures / Directive.

No employee of the contractor shall be positioned under a suspended load or between a suspended load and fixed objects.

All lifting equipment and accessories must have valid manufacturers certificates or thorough examination records and be uniquely identified, marked with the safe working load, listed in a register and subject to formal regular inspection as per EHS requirements and shall have valid certificates from a competent authority. Inspection before use by the operator is mandatory. All lifting hooks must have latch. All cranes shall be fitted with Automatic Safe Load Indicator (ASLI) and Anemo Meter.

The contractor shall operate and maintain cranes and hoisting equipment in accordance with manufacturers' specifications and limitations and the safety Requirements. All defective, non-inspected or unidentified (safe working load / identification number) lifting equipment or accessories must be either removed from site or physically prevented from use.

27. LOCKOUT TAGOUT (“LOTO”)

Prior to performing work on Machines or Equipment, the Subcontractor shall ensure that all energy sources are isolated and verify the absence of residual energy (e.g.: by using specific voltage detecting device for electricity).

At any time, the contractor shall follow the Site-specific LOTO and Permit to Work rules. The contractor must ensure that all of their affected Subcontractor Personnel receive the necessary training. Lockout/ Tagout must be implemented before servicing and maintenance is performed on Machines and Equipment, which could unexpectedly start-up, become energized, or release stored energy exposing persons to a risk of injury, unless the works undertaken are performed using alternative measures that provide effective protection.

Absence of residual energy must be verified using the suitable equipment or process adapted to the machine and the kind of energy to be checked before start of work. *The contractor must procure suitable VAV instrument for verification of absence of voltage before implementing LOTO all by themselves.*

When the contractor is in charge of LOTO, each authorized person must be issued with an individual lock with a unique key. The contractor shall secure areas where energy sources have been de energized, so as to prevent the access of unauthorized personnel and erect suitable signs. All affected Personnel shall be notified.

Once an item of electrical equipment has been energized, an item of mechanical plant and/or System has been erected and released for Commissioning, no work will be allowed on such item of Equipment or System unless a valid Permit to Work (PTW) has been obtained from the relevant authority.

28. MONTHLY SAFETY REPORT

Agency has to submit the monthly safety activity report in the form of Lead-Lag indicator to NTPC Safety Deptt. Sample format attached as annexure –IV.

- 29.** In case the Contractor doesn't adhere to any of the provisions of the NTPC Safety Rules for Construction and Erection of Power Plants, corresponding payment for the provisions not adhered, shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

SECTION-II

1. Safety at workplace and equipment

1.0 GENERAL PROVISIONS:

1.1. Housekeeping:

- a. The contractor shall be primarily responsible for maintaining Good housekeeping and safety standards in the workplace;
- b. Loose materials that are not required for use shall not be placed or left behind so dangerously as to obstruct workplaces or passageways;
- c. All projecting nails shall be removed or bent to prevent injury;
- d. Equipment, tools and small objects shall not be left lying unattended or unsecured from where they could fall or cause a person to trip;
- e. Scrap, waste or rubbish shall not be allowed to accumulate in the site as these combustibles can create serious fire hazards and affect safe working;
- f. Workplaces and passageways that become slippery owing to spillage of oil or other causes shall be cleaned up or strewn with sand, ash or the like;
- g. Portable equipment shall be returned after use to their designated storage place.

1.2. Means of access and egress shall consist of

- a. Adequate and safe means of access and egress shall be provided in all workplaces;
- b. The means of access and egress shall be maintained in a safe condition;

1.3 Lighting and ventilation

- a. All practical measures shall be taken to prevent smoke, fumes etc. from obscuring any workplace or equipment at which any worker is engaged;
- b. Adequate and suitable artificial lighting shall be provided where natural lighting is not sufficient as per IS 3646 (Part II). The artificial lighting so provided shall not cause any incidental any danger, including that of producing glare or disturbing shadows;
- c. To prevent danger to health from air contamination by dust generated during grinding, cleaning, spraying or manipulation of materials as also to provide protection against dangerous gases, fumes, vapours, mist, etc. effective arrangements shall be made for ventilation;
- d. Workers shall be provided with suitable respiratory protective equipment, if it is not technically possible to have uncontaminated air. To this end, a study by a competent person shall be made to decide on the due protection. Sufficient illumination at all times for maintaining safe working conditions shall be provided where building workers are required to work or pass, and for passageways, stairways and landings such illuminations shall not be less than 0.5 foot candles at the floor level;
- e. Where natural lighting is not adequate to prevent danger, adequate and suitable lighting shall be provided as per IS: 3646 – Part II;
- f. Artificial lighting shall not cause any danger due to a brightness greater than 10 foot candles per square inch, except where the angle of inclination from the eye to the source or the part pf the fitting as the case may be exceeds 20°, including that of producing glare or disturbing shadows;
- g. Where necessary to prevent danger to health from air contamination by dust from the grinding, cleaning, spraying, or manipulating of materials or objects, arrangements shall be made to limit the concentration of the pollutants by thorough ventilation, and dust generated due to movement of earthmoving machinery and other construction equipment, by spray of water in the area from time to time;
- h. Adequate ventilation by the circulation of fresh air shall be maintained in such places where the concentration of pollutants is likely to affect the health of the workers;

- i. Special care shall be taken to ventilate the workplace where gas cutting, welding or other operations involving generation of dangerous fumes, vapours, mists, gases etc is likely;
- j. Where it is technically not possible to eliminate dust or noxious or harmful fumes or gases sufficiently to prevent injury to the health of the workers, the contractor shall provide suitable respiratory equipment like dust mask or gas/fume mask or breathing apparatus or other suitable respiratory equipment.

1.4. Dangerous and harmful environment:

- a. When an internal combustion engine exhausts into confined space or excavation or tunnel or any other workplace where neither natural ventilation nor artificial ventilation system is adequate to keep the carbon monoxide content of the atmosphere below fifty parts per million, adequate and suitable measures shall be taken at such workplace in order to avoid exposure of building workers to health hazards;
- b. No building worker shall be allowed to enter any confined space or tank or trench or excavation wherein there is given off any dust fumes or other impurities of such nature and to such extent as is likely to be injurious or offensive to the building worker or in which explosives, poisonous, noxious or gaseous material or other harmful articles have been carried or stored or in which dry ice has been used as a refrigerant, or which has been fumigated or in which there is a possibility of oxygen deficiency, unless all practical steps have been taken to remove such dust, fumes or other impurities and dangers which may be present and to prevent any further ingress thereof, from such workplace or tank or trench or excavation;
- c. No worker shall be allowed to enter any such space unless a responsible person has certified it safe and fit for the entry of such building workers.

1.5. Fumes/gases due to Welding and gas-cutting operations: When welding or cutting operations are carried out in a confined space:

- a. Adequate ventilation, by means of exhaust fans or forced draught, as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be circulated by means of air compressors to dilute the contaminant within permissible limits;
- b. Workers shall take necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space;
- c. Welding or cutting operations on any container that has held explosives or where inflammable gases may have been generated, shall be undertaken after the container has been thoroughly cleaned by steam or other effective means; and
- d. Gas-test shall be carried out ensure that the confined space is completely free from combustible gases and vapours.

1.6. Dust, gases, fumes

- a. Concentration of dust, gases or fumes shall be prevented by providing suitable means to control their concentration within the permissible limit so that they may not cause injury or create health hazard to a building worker;

- b. For protection against such hazardous substances, besides efficient and effective means of control, personal protective equipment like dust masks, breathing apparatus, other respiratory appliances, goggles, as the case may be, shall be provided.

1.7. Excessive noise:

- a. Adequate measures shall be taken against the harmful effects of an excessive noise;
- b. Use of earplugs/muffs and anti-vibration gloves shall be ensured to protect the workers from the impact of exposure to such dangers;
- c. The noise level in no case shall exceed as prescribed in the concerned Rules and exposure in excess of 115 dBA over the period of a quarter of an hour cannot be permitted:

1.8. Corrosive substances:

- a. All corrosive substances, including alkalis and acids, shall be stored and used by a person dealing with such substances at a building or other construction work in such a manner that it does not endanger the building worker and suitable protective equipment shall be provided by the employer to a building worker during handling or use of such substances at a building or other construction work and in case of spillage of such substances on the building worker, immediate remedial measures shall be taken;
- b. While protection of the body could be ensured by use of corrosion resistant apparel/overalls, suitable goggles, gloves, apron, gum boots etc. shall be made available to all concerned personnel;
- c. To deal with an accidental spillage of a corrosive substance on the body of a worker, the facility of eyewash fountain or water shower, as the case may be, shall be installed, within the easy reach of the workplace.

1.9. Eye protection:

- a. Suitable personal protective equipment for the protection of eyes shall be provided and used by the building worker engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause hazard to his eyes;
- b. Goggles or face shield or welding screen with suitable shade of glass/filters etc shall be provided for the protection of the eyes.

1.10. Overhead protection:

- a. It shall be ensured that at the building or other construction site, overhead protection is erected along the periphery of every building under construction that shall be of fifteen meters or more in height when completed;
- b. Overhead protection shall not be less than two meters wide and shall be erected at a height not more than five meters above the base of the building and the outer edge of such overhead protection shall be one hundred fifty millimeters higher than the inner edge thereof or shall be erected at an angle of not more than twenty degrees to its horizontal sloping into the building;

- c. It shall be also ensured that at the building and other construction work that any area exposed to risk of falling material, articles or objects is roped or cordoned off or otherwise suitably guarded from inadvertent entry of persons other than building workers at work in such area.

1.11. Lifting and carrying of excessive weight:

- a. No building worker lifts by hand or carries overhead or over his back or shoulders any materials, articles, tools or appliances exceeding in weight the maximum limits as set out in the following table unless aided by any other building worker or a mechanical device;
- b. No worker aided by other workers, lift by hand or carry overhead or over their back or shoulders any materials, articles, tools or other appliances exceeding in weight the sum total of the maximum limits as prescribed in the concerned Rules, unless aided by a mechanical devices:

1.12. Protections against fall of persons –

- a. All scaffolds/working platforms at height of two metres or more shall be fenced;
- b. All guard-rails for the fencing of floor openings, gangways, elevated workplaces shall be made of sound material, good construction and possess adequate strength and be between 1 m and 1.5 m above platform level, consist of two rails (two ropes or chains may be used if they are sufficiently taut) and supporting stanchions;
- c. Intermediate rails, ropes or chains shall be midway between the top and lower of edges of the top rail;
- d. Sufficient number of stanchions or standard poles or uprights shall be maintained to ensure the required stability and resistance;
- e. Guard-rails shall be free from sharp edges and be maintained in good repair;
- f. Floor openings through which persons could fall, shall be guarded by covering or fencing;
- g. If the means of protection is removed to allow the passage of persons or goods or other purpose, the same shall be replaced as soon as possible, while making temporary arrangements for reasonable degree of safety in the meanwhile;
- h. Covers for floor opening shall be safe to walk on and if vehicles operate thereon it shall be safe for the same. This will require the contractor to have prior assessment of expected loads;
- i. Cover for floor opening shall be secured by hinges, grooves, stops or other effective means against sliding, falling down or lifting out or any other inadvertent displacement;
- j. Covers for any openings shall not constitute any hindrance to traffic and, as far as practicable, be flush with the floor;
- k. If covers constitute as grids, the bars shall be spread not more than 5 cm apart;
- l. Elevated workplaces at more than 2 m above the floor or ground shall be protected on all open sides by guardrails. It is commonly observed that fragile barricade tapes are used as a substitute of a strong and dependable fencing. This practice is prohibited. The barricade tapes can be used as markers/route guide only;
- m. Elevated workplaces shall be provided with safe means of access and egress such as stairs, ramps or ladders according to suitability;
- n. Persons employed at elevated workplaces or other situations at more than 2m from which they may fall, shall be protected by means of adequate safety nets, or platforms, or be secured by

safety belts with the lanyard properly anchored above the head level of the user. All possible effort shall be made to have strong and dependable mechanical arrangement.

1.13. Protection against fall of objects and materials:

- a. Materials and objects such as scaffolding materials, waste materials or tools shall not be thrown up or down from heights, as they are liable to cause injury;
- b. If materials and other objects cannot be safely lowered from heights, adequate precautions such as the provision of fencing, lookout men or barriers shall be provided to protect any person from injury.

1.14. Protection against entry of unauthorized persons:

- a. Construction zones in the site and built up areas alongside main traffic routes shall be barricaded;
- b. Unauthorized persons shall not be allowed access to construction sites and visitors shall be provided with the required protective equipment and it be ensured that they use them effectively.

1.15. Head protection and other protection apparel:

Every building worker who is required to –

- a. Pass through or working within the areas where there is hazard of his being struck by falling objects or materials, shall be provided with safety helmets of the type approved and tested in accordance with the national standards;
- b. Work in water or in wet concrete or in other similar work, shall be provided with suitable waterproof;
- c. Work in rain or in similar wet condition, shall be provided with waterproof coat with hat;
- d. Workers using or handling of alkalis, acid or other similar corrosive substances shall be provided with appropriate protective equipment in accordance with the approved standards;
- e. Every building worker engaged in handling sharp objects or materials at a building or other construction work, which may cause hand injury, shall be provided with suitable hand gloves in accordance with the approved standards.

1.16. Stability of structures:

- a. No wall, chimney or other structure or part of a structure shall be left unsupported in such condition that it may fall, collapse or weaken due to wind pressure, vibration or due to any other reason. Entry of persons into such locations where tall structures are being built shall be regulated without a let up.

1.17. Safety of Structures and equipment and other safety concerns

- a. Safety of structures like scaffoldings, platforms, gangways/walkways, towers, stairs, ladders, ramps, safety in excavation, formwork, falsework, demolition work, storage, handling and use of explosives, inflammable substances and hazardous materials, gas cutting and welding, use of electricity etc.; and equipment viz. construction machinery, crushers and batching plant, boiler and other pressure vessels, transport and material handling equipment, lifting appliances, vehicles etc., shall be operated and maintained as per approved norms and –
 - i. They shall be made of sound material and of good construction, free from patent defects, provided with adequate safe guards, properly maintained, periodically inspected and strong enough to withstand safely the loads and stresses to which they may be subjected;
 - ii. They shall carry enough factor of safety bearing in mind that the possibility of their abuse, which otherwise shall be prevented by constant and adequate supervision, cannot be ruled out altogether;
 - iii. It is incumbent on the contractor to ensure that only competent and authorized persons operate the equipment or attend to electrical and mechanical systems and repair of faults or breakdowns etc.
- b. Working in the confined space may involve certain serious hazards. Strict adherence to the conditions of Permit-to-work issued for the purpose is required;
- c. Control of energy sources shall be ensured through Log-out/Tag-out practices.

1.18. Slipping, tripping, cutting, drowning and falling hazards:

- a. The contractor shall keep all passageways, platforms and other places free from accumulations of dust, debris or similar material and from other obstructions that may cause tripping;
- b. Any sharp projections or protruding nails or similar projections which may cause any cutting hazard to a building workers shall be removed or otherwise made safe by taking suitable measures;
- c. No contractor shall allow any building worker at construction work to use the passageway, or a scaffold, platform or any other elevated working surface which is in slippery and dangerous condition and shall ensure that water, grease, oil or other similar substances which may cause the surface slippery, be removed or sanded/saw-dusted or covered with suitable material to make it safe from slipping hazard;
- d. Wherever building workers are exposed to the hazard of falling into water, they shall be provided with rescuing arrangement from such hazard and if it is considered necessary, well equipped boat or launch manned with trained personnel shall be provided by the contractor at the site of such work;
- e. Every open side or opening into or through which a building worker, vehicle or lifting appliance or other equipments may fall at a building or other construction work shall be covered or guarded suitably to prevent such fall except where free access is necessary by reasons of their nature of the work;
- f. Wherever building workers are exposed to the hazards of falling from height while employed on such work they shall be provided by the employer with adequate equipment or means for

saving them from such hazards, Such equipments or means shall be in accordance with the standards as laid down;

- g. Whenever there is a possibility of falling of any martial, equipment or building worker at a construction site relating to a building or other construction work, adequate and suitable safety net shall be provided in accordance with the above stipulation;

2.0 SAFETY IN MATERIAL HANDLING AND WASTE DISPOSAL

2.1. GENERAL PROVISIONS:

- a. All building materials stored in tiers shall be stacked, racked, blocked, interlocked or otherwise secured safely to prevent sliding, falling or collapse and in an orderly manner to avoid obstruction of any passageway at the place of work. Piles of materials shall be stored or stacked in such a manner as to ensure their stability;
- b. Maximum safe load limits of floors within buildings and structures in kg/cm² shall be conspicuously posted in all storage areas, except for floor or slab on gradient. Maximum safe load shall not be exceeded. Material or equipment shall not be stored upon any floor or platform in such quantity as to exceed its safe carrying capacity;
- c. Ailes and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or persons. Such areas shall be kept in good repair;
- d. When a difference in road or working levels exist, means such as ramps, blocking or grading shall be used to ensure the safe movement of vehicles between two levels;
- e. Material stored inside buildings under construction shall not be placed within 2 m of any hoist way or inside floor openings nor within 3.2 m of exterior wall which does not extend above the top of material stored;
- f. Persons employed required to work on stored material in silos, hoppers and similar storage areas shall be equipped with lifelines and safety belts;
- g. Non-compatible materials shall be segregated in storage;
- h. Bagged materials shall be stacked by stepping back the layers and cross-keeping the bags at least every 10 bags high;
- i. Materials shall not be stored on scaffolds or runways in excess of supplies needed for immediate operations;
- j. Bricks stacks shall not be more than 2.2 m in height. When a loose brick stack reaches a height of 1.3 m it shall be tapered back 5 cm in every foot of height above the 1.25 m level;
- k. When masonry blocks are stacked higher than 2 m, the stack shall be tapered back on half block per tier above the 2 m level;
- l. Material or equipment shall not be stored or placed so close to any edge of a floor or platform as to endanger the safety of persons below or working in the vicinity. Where stacking, unshackling, stowing or unstaring of construction material or article, or handling in connection therewith cannot be safely carried out unaided, reasonable measures to guard against accident or dangerous occurrences shall be taken by shoring or otherwise to prevent any danger likely to be caused by such handling;
- m. Stacking of material or article shall be made on firm foundation not liable to settle and such material or article and shall not overload the floor on which such stacking is made;

- n. The material or articles shall not be stacked against partition or walls of a warehouse or stores unless it is known that such partition or the wall is of sufficient strength to withstand the pressure of such materials or articles;
- o. The materials or articles shall not be stacked to such a height and in such a manner as would render the pile of such stack unstable and cause hazards to the building workers or the public in general;
- p. Where the building workers are on stack exceeding one point five meters in height, safe means of access to the stack shall be provided;
- q. All stacking or unstacking operations shall be performed under the supervision of a responsible person for such stacking or unstacking;
- r. The stacking of construction materials or articles shall not be made near the site of excavation, shaft, pit or any other such opening;
- s. Stacks that may lean heavily or become unstable or collapse are barricaded shall be avoided;
- t. Structural steel, poles, pipe, bar stock and other cylindrical materials, unless racked, shall be stacked and blocked so as to prevent sliding, spreading or tilting.

2.2. LUMBER:

- a. Used lumber shall have all nails withdrawn before stacking;
- b. Lumber shall be stacked on level and solidly supported sills;
- c. Lumber piles shall not exceed 6 m in height provided that lumber is handled manually, shall not be stacked more than 5 m height;
- d. Lumber shall be so stacked as to be stable and self-supporting.

2.3. STACKING OF CEMENT AND BAGS CONTAINING OTHER MATERIALS:

- a. The cement or other material in bags shall be stacked in a header and stature-wise in rows alternately in not more than 10 numbers and there will be circulation of space of at least 600 mm in between two such rows;
- b. While removing bags from the stack pile the stability of such stack pile shall be ensured;
- c. Bags containing cement or lime shall be stored on a firm ground;
- d. The materials like bricks, tiles or blocks shall also be stored on a firm ground;
- e. Reinforcing steel shall be stored according to its shape, size and length and stack of reinforcing steel kept as low as possible;
- f. No pipe shall be stored on rack or in stack where such pipe is likely to fall by rolling;
- g. The angle of repose shall be maintained where loose materials are stacked;
- h. When dust laden material is to be stored or handled, measures shall be taken to suppress the dust produced by such storing or handling and suitable personal protective equipment supplied to and used by the building workers working for such storing or handling.

2.4. DISPOSAL OF DEBRIS AND WASTE MATERIAL:

- a. It shall be ensured that debris is
 - i. Handled and disposed of by a method, which does not cause danger to the safety of a person and not allowed to accumulate so as to constitute a hazard;
 - ii. Kept sufficiently moist to bring down the dust under control;
 - iii. Not thrown inside or outside from any height of such building or other construction work;
- b. Brought down by suitable means/chutes provided for the purpose and on completion of work, leftover building material, article or other substance or debris shall be disposed off as soon as possible to avoid any hazard to any traffic or person;
- c. Whenever materials are dropped more than 6 m to any point lying outside the exterior walls of the building an enclosed chute of wood, or equivalent material shall be used;
- d. When debris is dropped through holes in the floor without the use of chutes, the area where the material is dropped shall be completely enclosed with barricades not less than 1.1 m high and not less than 1.9 m back from the edge of the opening above. Signs warning of the hazard of falling material shall be posted at each level;
- e. All scrap lumber, waste material and rubbish shall be removed from the immediate work area as the work progresses;
- f. Disposal of waste material or debris as per the guideline issued by CPCB in compliance of Rule 10 sub-rule 1(a) of C & D Waste Management Rules, 2016).
- g. All bio-degradable material shall be disposed off in the pit for making compost. Pellets can also be made from bio-degradable material
- h. All solvent wastes, oil rags and flammable liquids shall be kept in fire resistant covered containers until removed from the work site.

2.5. HANDLING GAS CYLINDERS:

- a. Gas cylinders shall not be lifted on bare slings. For lifting the cylinders, cage of suitable size shall be used and all cylinders shall be horizontally positioned in it. Such cage shall have fencing in such a way that there is no possibility of fall of cylinders from this cage.

2.6. RIGGING EQUIPMENT FOR MATERIAL HANDLING:

- a. Rigging equipment for material handling shall be inspected prior to use in each shift as necessary during its use to ensure that it is safe. Defective rigging equipment shall be removed from service;
- b. Rigging equipment shall not be loaded in excess of its recommended safe working load, as prescribed in the Indian standards;
- c. Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to persons engaged in the area;

- d. Special custom designed grabs, hooks, clamps, or other lifting accessories, for such units as modular panels, prefabricated structures and similar materials, shall be marked to indicate the safe working loads shall be proof tested prior to use 125% of their rated load;
- e. Welded alloy steel chain slings shall have permanently affixed-durable identification standing size, grade, rated capacity and manufacturer.

2.7. FENCING OF MOTORS ETC

- a. All motors, cogwheels, chains and friction gearings, flywheels, shafting and the other dangerous and moving parts of machinery (whether or not driven by mechanical power) and steam pipes shall be securely fenced and the fencing of dangerous parts of machinery not removed while such machinery is in motion or in use;
- b. No part of any machinery which is in motion and which is not securely fenced, shall be examined, lubricated, adjusted or repaired except by a person skilled and trained for such examination, lubrication, adjustment or repairs and machine parts cleaned only when such machine is stopped;
- c. When a machine is stopped for servicing or repairs, adequate measures shall be taken to ensure that such machine does not restart inadvertently and not only tag-out sign is required; it is also essential that an active system of isolating the power be applied.

2.8. PROTECTION AGAINST LIGHTNING

- a. Where necessary, installations shall be protected against lightning, provided further that;
- b. No bare conductors or bare current-carrying parts of equipment be permitted to be installed unless adequate precautions are taken to prevent direct or indirect contact;
- c. Only flame-proof equipment and conductors shall be installed at places where explosives or inflammable substances are stored, handled or used or where explosive atmosphere exists;
- d. Persons competent and authorized only shall attend to electrical breakdowns and other operational faults and give or restore power to an equipment and such persons shall be easily identifiable by their dress or special helmet worn;
- e. It will constitute a standard practice to switch off portable tools while shifting from one place to another or while leaving them behind unattended;
- f. The contractor shall ensure that a system is in place to always keep tools well maintained.

2.9. VEHICULAR TRAFFIC

- a. Whenever any building or other construction work is being carried on, or is located in close proximity to a road or any other place where any vehicular traffic may cause danger to building workers, it shall be ensured that such building or other construction work is barricaded and suitable warning signs and lights displayed or erected to prevent such danger and if necessary, a request in writing made to the concerned authorities to control such traffic;

- b. All vehicles used at construction site shall comply with the requirements of the Motor Vehicles Act, 1988 (59 of 1988) and the Rules made hereunder;
- c. The driver of a vehicle of any class or description operating at a construction site shall hold a valid driving license under the Motor Vehicles Act. 1988 (59 of 1988).

2.10. USE OF SAFETY BELT OR OTHER FALL ARREST SYSTEMS:

Wherever any work at a height of 3 m or more is carried out, use of a suitable fall arrest system is mandatory if the workplace has already not been provided with an otherwise reliable means of protection for preventing the fall of persons from that height, provided further that:

- a. Safety belt, lanyard, life lines and devices for the attachment of such life lines shall conform to the approved standards;
- b. Every building worker shall be supplied with safety belt and safety life lines for his protection and such building worker shall use such belts and life lines during the performance of his work;
- c. All building workers using safety belt and safety life lines shall have the knowledge of safe use and maintenance of such belts and life lines and shall be supplied with necessary instructions for its use;
- d. The responsible person for supervising the use of safety belts and safety lifelines shall inspect and ensure that such safety belts and lifelines are fit for use before taking them into use.

2.11. SAFETY NET AND ITS USE

- a. Every safety net shall be of adequate strength, made of sound material and suitable for use and conform to the approved standards;
- b. The responsible person for maintenance of safety nets and their use shall ensure safe fixing of such safety nets and provide such safety nets with suitable and sufficient anchorage so that the purposes for which such safety net is intended for use is served;
- c. Use of multi-layer safety net to be ensured to avoid fall of material/objects.

2.12. STORAGE OF SAFETY BELTS AND NETS, ETC:

- a. Proper arrangement shall be made for the safe storage of safety belts, safety lifelines and safety nets when they are not in use and are protected against mechanical damage, damages from chemicals and damages from biological agents.

2.13. SAFETY HELMETS AND SAFETY FOOTWEAR

- a. The Engineer in-charge may declare whole or part of a site as the hardhat area and in such an eventuality it shall be the responsibility of the contractor to provide safety helmet of the approved quality to all personnel engaged in construction and erection work, including the visitors to the site;
- b. Accordingly, wherever safety footwear is required for the safety of the personnel, the contractor shall provide the same of the approved type free of charge.

3.0 WELDING AND GAS CUTTING OPERATIONS

3.1 GAS WELDING:

3.1.1 GENERAL PROVISIONS:

- a. All welders shall be provided with fire resistant protective clothing and equipment, such as fire resistant gauntlets and aprons, helmets and goggles with suitable filter lenses and its usage shall be ensured;
- b. The welders shall not be allowed to wear clothing that is not free from grease, oil and other flammable material;
- c. Adequate precautions shall be taken to protect persons working or passing near welding operations from dangerous sparks and radiation;
- d. When welding or cutting is being done on materials containing toxic or harmful substances or liable to produce toxic or harmful fumes, adequate precautions shall be taken to protect workers from the fumes, either by
 - i) Exhaust ventilation, or
 - ii) Respiratory protective equipment;
 - iii) Arrangement shall be made so that welding sparks do not fall down on the persons working below or material, which are combustible in nature and may be damaged with such sparks.
- e. The oxygen pressure for welding shall always be high enough to prevent acetylene flowing back into the oxygen cylinder;
- f. Acetylene shall not be used for welding at a pressure exceeding 1 atmosphere gauge;
- g. Adequate precautions shall be taken to prevent:
 - i) Fire being started by sparks,
 - ii) Slag or hot metal; and
 - iii) Damage to fibre ropes from heat, sparks, slag or hot metal;
- h. Precautions shall be taken to prevent flammable vapours and substances from entering the working area;

3.2. WELDING AT PLACES WITH FIRE RISKS:

- a. Unless adequate precautions are taken, no welding or cutting operations shall be allowed near the place where combustible materials are stored, or near materials or plant where explosive or flammable dusts, gases or vapours are likely to be present or given off. If hot work permit system exists at the site, the same shall be followed;
- b. Combustible materials and structures that cannot be removed from the vicinity of welding operations shall be shielded by asbestos or protected by other suitable means.

3.3. WELDING IN CONFINED SPACE:

When welding or cutting operations are being carried out in a confined space;

- a. Adequate ventilation, by means of exhaust fans or forced draught as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be blown in by means of compressors to dilute the pollutants;

- b. No blow pipe shall be left unattended inside a tank or vessel or other confined space during meal break or other interruption of the work;
- c. The worker shall take all necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space; and
- d. When necessary to prevent danger, an attendant shall watch the welders from outside.

3.4. WELDING ON CONTAINERS FOR EXPLOSIVE OR FLAMMABLE SUBSTANCES:

Welding or cutting operations on containers in which they are explosives or flammable substances shall not be allowed;

- i) Welding or cutting operations on any container that has held explosive or where flammable gases may have been generated, shall only be undertaken,
- ii) After the container has been thoroughly cleansed by steam or other effective means; and
- iii) Found by air tests to be completely free from combustible gases and vapours; or
- iv) After the combustible gas in the container has been completely replaced by an inert gas or by water;
- v) If an inert gas is used as laid down in clause 4.2.3, after the vessel has been filled with gas, the gas shall continue to flow slowly into it thorough out the welding or cutting operations;
- vi) Before starting any welding operations on, or otherwise applying heat to, closed or jacketed containers or other hollow parts, such containers or parts shall be adequately vented in suitable manner.

3.5. GAS CYLINDERS

- a. Gas cylinders shall be inspected, stored, handled and transported in conformity with the requirements of Gas Cylinders Rules, 1981;
- b. When in use, cylinders shall be held in upright positions by straps, collars or chains;
- c. Devices referred to in clause 6.2 shall be such that the cylinders can be rapidly removed in an emergency;
- d. Welders shall not temper with or attempt to repair safety devices and valves on gas cylinders;
- e. When acetylene cylinders are coupled, flash back arrestor shall be inserted between the cylinder and the coupler block, or between the coupler block and the regulator;
- f. Only acetylene cylinders or approximately equal pressure shall be coupled;
- g. No gas shall be taken from a cylinder unless a pressure reducing regulator has been attached to the valve;
- h. Only the right pressure reducing regulator shall be used for the gas in the cylinder;
- i. Cylinder valves shall be kept free from gases, grease, oil, dusts and dirt;
- j. Leaky cylinders charged with acetylene or liquefied fuel gas shall be taken into the open air at a safe distance from any open flame or sparks.

3.6 HOSE

- a. Only hose especially designed for welding and cutting operations shall be used to connect an oxy-acetylene torch to gas outlet;
- b. Hose lines for oxygen and for oxy-acetylene shall be of different colours and preferably of different size;
- c. Hose connections shall be sufficiently light to withstand without leakage a pressure twice the maximum delivery pressure of the pressure regulators in the system;

- d. Care shall be taken that hose does not become kinked or tangled, stepped on or run-over or otherwise damaged;
- e. Any length of hose in which a flashback has burned, shall be discarded;
- f. No hose with more than one gas passage shall be used;
- g. Only soapy water shall be used for testing hose for leaks.

3.7. TROCHES

- a. When torches are being changed, the gases shall be shut off at the pressure reducing regulators and not by crimping hose;
- b. Torches shall be lit with friction lighters or other safe source but not with matches.
- c. Electric welding equipment:
- d. Welding machines shall be controlled by a switch mounted on or near the machine framework that, when opened, immediately cuts off the power from all conductors supplying the machine;
- e. Welding circuit shall be so designed as to prevent the transmission of high potential from the source of supply to the welding electrodes;
- f. The maximum open circuit voltage shall be in accordance with Indian Standards;
- g. Electrode conductors or cables shall not be excessive in length and shall not be longer than necessary to perform the work;
- h. Return conductors shall be taken directly to work and securely connected mechanically and electrically to it or to the work bench, floor etc. and to an adjacent metallic object;
- i. Cable shall be supported so as not to create dangerous obstruction;
- j. Motors, generators, rectifiers and transformers in arc welding or cutting machines, and all current carrying parts, shall be protected against accidental contact with uninsulated live parts;
- k. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot;
- l. Frames of arc welding machines shall be effectively earthed;
- m. In hand-operated arc welding machines, cables and cable connectors used in arc welding circuits shall be effectively insulated on the supply side;
- n. The outer surface electrode holders of hand-operated arc welding machines, including the jaw so far as practicable, shall be effectively insulated;
- o. Electrode holders of hand-operated arc-welding machines shall, if practicable, be provided with discs or shields to protect the operator's hands from the heat of the arcs;
- p. Only heavy-duty cable with unbroken insulation shall be used;
- q. Circuit connections shall be waterproof;
- r. When lengths of cable have to be joined, only insulated connectors shall be used on the earth line and the electrode holder line;
- s. Connections to welding terminals shall be made at distribution boxes, socket outlets, etc. by bolted joints;
- t. Welding terminals shall be adequately protected against accidental contact by enclosures, covers or other effective means;
- u. Electrode holder shall
 - i. Have adequate current capacity;
 - ii. Be adequately insulated to prevent shock, short-circuiting or flashovers.

3.8. OPERATIONS

- a. Arc welding and cutting operations that are carried on at places where persons other than the welders are working or passing shall be enclosed by means of suitable stationary or mobile screens;
- b. Walls and screens of both permanent and temporary protective enclosures shall be provided to absorb harmful rays from the welding equipment and prevent reflection, and if necessary, be painted or otherwise treated for the purpose;
- c. When arc welding is done in damp confined spaces;
 - i) Electrode holders shall be completely insulated; and
 - ii) The welding machines shall be outside the confined space;
- d. Welders shall take adequate precautions
 - i) To prevent any part of their body from completing an electric circuit
 - ii) To prevent contact between any part of the body and the exposed part of the electrode, or electrode when in contact with metal; and
 - iii) To prevent wet or damaged clothing, gloves and boots from touching any live part;
- e. Welding circuits shall be switched off when not in use;
- f. Electrodes shall only be inserted in the holder with insulating means such as insulating gloves;
- g. Electrode and return leads shall be adequately protected against damage;
- h. Live parts of electrode holders shall be inaccessible when they are not in use;
- i. Electric arc-welding equipment shall not be left unattended with current switched on.

4.0 SAFETY IN THE USE OF ELECTRICITY

4.1. GENERAL PROVISIONS

- a. Before commencement of any building or other construction work, adequate measures shall be taken to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuit which may cause electrical hazard during the course of his employment and suitable warning signs shall be displayed and maintained at conspicuous places in Hindi and in local language understood by the majority of the building workers;
- b. In workplaces where the exact location of underground electric power line is not known, the building workers using jack hammers, crow bars or other hand tools which may come in contact with a live electrical line shall be provided with approved insulated protective gloves and footwear;
- c. As far as practicable, no wiring or cable, which may come in contact with water or which may be mechanically damaged or which may result in electric shock shall be left on ground or;
- d. All electrical appliances and current carrying equipment used shall be made of sound material and adequately earthed;
- e. All temporary electrical installations shall be provided with earth leakage circuit breakers;
- f. It is required that all portable power-driven hand tools are provided with double insulation to secure a high degree of protection from electrical hazards;
- g. Electrical installations shall comply with the requirements of any law for the time being in force, especially the Indian Electricity Act/Rules in particular with specific reference to the following:
 - i) All parts of installations shall be of standard construction not lower, from the safety point of view, than the national standards, as applicable. All parts of electrical installations shall be so constructed, installed and maintained so as to prevent electrical fires, explosion and shock;
 - ii) Earthing of metal work of electrical equipment, other than the parts which carry current, shall be provided and will conform to Electricity Act and IS: 3042 – 1966 (code of practice for earthing);
- h. All parts of electrical installation shall be adequate size and characteristics for the work they may be called upon to do and in particular they shall:
 - i) Be of adequate mechanical strength to withstand working conditions in construction operations; and
 - ii) Be not liable to damage by water, dust or electrical, thermal or chemical action to which they are subjected to in construction operations;
- i. All parts of electrical installations shall be so constructed, installed and maintained as to prevent the danger of electric shock; fire and external explosion;
- j. It shall be made impossible for circuit breakers to be opened or closed inadvertently, by gravity or by mechanical impact;

- k. Before operation of OCBs, oil level must be checked and the event of short, extra quantity must be filled;
- l. Use of rubber gloves and rubber gum boots of tested quality where electric shock is likely to occur shall be provided, but these shall not be considered as providing adequate protection against the risk of electric shock in lieu of inbuilt safety arrangement in the system;
- m. First-aid boxes, instruction for restoration of persons affected by electric shock shall be made;
- n. Arrangement shall be made for sufficient number of CO₂/chemical powder type fire extinguishers/sand buckets etc.;
- o. No electrical circuits shall ever be overloaded to the dangerous extent or beyond the rated capacity;
- p. In confined areas, only 24 volt supply shall be used for every equipment, including hand-held portable tools and hand lamps;
- q. All electrical appliances and outlets shall be clearly marked to indicate their purpose and voltage.

4.2. FUSES

- a. Fuses shall bear markings indicating their rated current, whether they are of the fast or slow-breaking type and, as far as practicable, and their rated breaking capacity. Fuses as per need and of correct rating shall be used in the circuit;
- b. Effective measures shall be taken to ensure that persons removing or inserting fuses will not be endangered, in particular by any adjacent live parts;
- c. In case of blow of fuses only after finding out and correcting of the fault, new fuses shall be provided in the circuit.

4.3. SWITCHES

- a. All switches shall be of enclosed type and so installed and earthed as to prevent danger in their operation;
- b. Use of switches, which may connect or disconnect circuit through gravity, shall not be used.

4.4. MOTORS

- a. All motors shall be equipped with a switch;
- b. When a motor can be cut off from more than one place, where practicable, a stopping device shall be installed in the immediate vicinity of the motor;
- c. Motors shall be so installed as to ensure that they can be adequately cooled;
- d. Motors shall be effectively protected against over current;
- e. Whenever the motors installed are in the open area where there is the possibility of fall of liquid corrosives or otherwise, it shall be suitably protected with covering;
- f. Earthing shall be connected to all motors, generators etc. as prescribed in the Indian Electricity Rules, amended from time to time.

4.5. CONNECTIONS

- a. At points where conductors are joined, branched or led into apparatus, they shall be:
 - i. Mechanically protected, and
 - ii. Properly maintained;

- b. Conductors shall be joined, branched or led into an apparatus through junction boxes, bushings, glands or equivalent connecting devices;
- c. Junction boxes or plug-out-socket couplings shall be used for joining cables wherever practicable;
- d. When parts of conductors are joined together, or conductors are joined to one another or to an apparatus, the attachment shall be made by screwing, clamping, soldering, riveting, brazing, crimping, or equivalent means. Loose connections shall not be provided in any case;
- e. Cable joints, junction boxes and connectors shall be protected as far as practicable, against traffic, fall of ground, water and other sources of damage;
- f. Whenever armoured cables are joined, the junction boxes shall be bridged by a suitably conductive bond between the armouring of the cables.

4.6. TRANSPORTABLE AND PORTABLE ELECTRICAL EQUIPMENT:

- a. The supply of electricity to portable apparatus shall not exceed 250v;
- b. Hand-held and portable machines shall be equipped with a built-in switch to switch off power in case of emergency;
- c. Hand-held electrically operated tools shall be provided with built-in switch to disconnect the circuit when the tool is not being used;
- d. Portable electrical tools, unless flameproof, shall not be used in flammable or explosive atmosphere;
- e. Only three-core cable shall be used for single-phase operated tools with the third core connected to earth

4.7. HAND LAMPS

- a. Hand lamps shall be equipped with strong cover of glass or other transparent material;
- b. Portable lamp holders shall have:
 - i) All current –carrying parts enclosed;
 - ii) Insulated handle; and
 - iii) They shall operate at 24 v;

4.8. INSPECTION, MAINTENANCE

- a. All electrical equipment shall be inspected before it is taken into use to ensure that it is suitable for its purpose of use;
- b. At the beginning of every shift every person using electrical equipment shall make a careful external examination of the equipment and conductors for which he is responsible, especially flexible cables;

- c. Periodic inspections, testing, maintenance of all electrical equipment is to be made and record of test of transformer oil and pit earthing shall be maintained;
- d. Electrical conductors and equipment shall be repaired by the electrician only as far as practicable, no work shall be done live conductors or equipment;
- e. Before any work is begun on conductors or equipment that does not have to remain live;
 - i) The current shall be switched off;
 - ii) Adequate precautions shall be taken to prevent the current from being switched on again;
 - iii) The conductors or the equipment shall be tested to ascertain that they are dead;
 - iv) The conductor and equipment shall be earthed and short-circuited; and
 - v) Neighbouring live parts shall be adequately protected against accidental contact;
- f. After work on conductors and equipment, the current shall only be switched on again on the orders of a competent person;
- g. Electricians shall be provided with adequate tools, and person protective equipment, such as rubber gloves, mats etc.;
- h. All conductors and equipment shall be considered to live unless there is certain proof to the contrary.

4.9. WORK IN THE VICINITY OF ELECTRICAL INSTALLATION

- a. When work is to be done in the neighborhood of electrical conductors or installations, the contractor shall ascertain the voltage carried and the works shall not be allowed to reach to unsafe distance from them;
- b. When any excavation is to be made or any bore-holed sunk, the contractor shall ascertain whether there are any underground conductors, in or in dangerous proximity to, the zone of operations;
- c. No work shall be done in dangerous proximity to a conductor or an installation until it has been made dead;
- d. Before work begins, work permit shall be obtained from the Engineer in-charge if live electricity lines/circuit are passing in close vicinity;
- e. Before the current is restored, the contractor shall ensure that no work remain on the work site;
- f. If conductor or an installation in the neighbourhood of which work is to be done can not be made dead, special precautions shall be taken and special instructions given to the workers so as to prevent danger by adequately enclosing or fencing;
- g. If mobile equipment has to be employed in the neighbourhood of conductors or installations that cannot be made dead, its movement shall be so controlled as to keep it as a safe distance from them.

5.0 SAFETY IN THE USE OF HAND TOOLS AND POWER-OPERATED TOOLS

5.1 GENERAL PROVISIONS

- a. All hands and power tools and similar equipment, shall be maintained in safe condition.
- b. When power operated tools are designed to accommodate guards, they shall be equipped with such guards, when in use;
- c. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
- d. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapours, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;
- e. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive **on-off control**.
- f. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

5.2. HAND TOOLS

- a. The contractor shall not issue or permit the use of unsafe hand tools;
- b. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;
- c. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
- d. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

5.3. POWER OPERATED TOOLS

- a. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
- b. The use of electric cords for hoisting or lowering loads shall not be permitted;
- c. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected;
- d. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled;
- e. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm² pressure at the tool a safety device on the

muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;

- f. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm² and that too with effective chip guarding. The 2 kg/cm² pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;
- g. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
- h. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
- i. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;
- j. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;
- k. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;
- l. Loaded tools shall not be left unattended;
- m. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;
- n. Driving into materials that can be easily penetrated shall be avoided unless backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
- o. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
- p. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
- q. All tools shall be used with the correct shield, guard or attachment as recommended by thee manufacturer.

5.4. ABRASIVE WHEELS AND TOOLS

- a. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
- b. Grinding machines shall be equipped with suitable safety guards;
- c. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 90⁰, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 120⁰. In either case, the exposure shall begin not more than 65⁰ above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
- d. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;

- e. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
- f. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of accidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180°;
- g. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
- h. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used;
- i. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
- j. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
- k. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

5.5. WOODWORKING TOOLS

- a. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the **off-position**;
- b. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is retensioned for a different speed, the marking shall be corrected to show the new speed;
- c. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;
- d. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

6.0 SAFETY IN THE USE OF LADDERS AND STAIRS

6.1. GENERAL ASPECTS OF SAFETY RELATED TO USE OF LADDERS

- a. Every ladder or step-ladder used in building or other construction work shall be of good construction, made of sound material and of adequate strength for the purpose for which such ladder or step-ladder is used;
- b. When a ladder is used as a means of communication, such ladder shall be lashed to a fixed structure so that while working on such ladder it does not slip;
- c. A ladder or step ladder shall not stand on loose bricks or other loose packing and have a level and firm footing;
- d. No ladder shall be used which has a missing or defective rungs or rungs, which depend for support solely on nails, spikes or other similar fixing.

6.2. MATERIALS FOR LADDERS

- a. Shall be constructed with upright of adequate strength and are made of straight-grained wood, free from defects and having the grain of such wood running length wise;
- b. Shall have rungs made of straight-grained wood free for defects and mortised or securely notched into the upright, reinforcing metal ties, if wedges shall not secure the tenors of such ladders;
- c. Where it is required, in case of use of fixed ladders, sufficient foot-hold and hand-hold shall be provided for use by the building worker;
- d. Every ladder shall be -
 - i. Secured so as to prevent undue swaying;
 - ii. Equally and properly supported on each of its upright;
 - iii. So used as not to cause undue sagging; and
 - iv. Placed as nearly as possible at an inclination of four in one;
- e. The use of all ladders and stepladders shall conform to the approved standards;
- f. Wooden ladders shall be constructed with uprights of adequate strength as well as rungs made of wood free from visible defects and having the grains of the wood in the ladders running lengthwise and rungs mortised or rebuted into the uprights;
- g. Uprights and rungs of metal ladders shall have a cross-section adequate to prevent dangerous deflection, shall be equal and not less than 25 cm or more than 35 cm;
- h. Rungs of metal ladders shall be kept clean so as to prevent them from becoming slippery;
- i. Portable ladders shall not exceed 9 m in length;
- j. Every ladder or run of ladders rising to a height exceeding 9 m shall be provided with an intermediate landing, providing further that the intervals between landings shall not exceed 9 m. The landings shall be of suitable size and protected by railings;
- k. Defective ladders that cannot be satisfactorily repaired shall be tagged Not Fit For Use and destroyed;
- l. Wooden ladders shall not be painted, but oiled or covered with clean varnish or other transparent preservatives;
- m. Metal ladders shall be protected against corrosion by being coated with rust-proof paint or by other means unless they are made of non-corrosive metals;

- n. Every ladder shall rise at least 1 m above the highest point to be reached and have one of the uprights continued to that height to serve as a hand-rail at the top;
- o. Ladders shall not stand on loose bricks or other loose packing but have a level and firm footing so that they are equally supported on each upright;
- p. Every ladder shall be securely fixed so that it cannot move from its top and bottom points of rest and if it cannot be secured at the top, it shall be securely fastened at the base and if fastening at the top is also impracticable, it shall have a man stationed at the foot holding the end to prevent it from slipping;
- q. Where a run of two or more ladders connects different floors, the ladders shall be staggered and a protective landing with the smallest practicable opening shall be provided at each floor;
- r. A ladder having only one upright or a missing or dangerously defective rung shall not be used;
- s. When a ladder is placed in position, the distance between the foot of a ladder and the base of the structure against which it rests shall be about one-quarter of its length;
- t. Workers using ladders shall leave at least one hand free for climbing up and down, face the ladder, avoid wearing slippery footwear and avoid carrying heavy or bulky loads;
- u. A ladder shall not be placed in front of a door that opens towards it unless the door is fastened or locked or guarded;
- v. A ladder shall not be placed against a window frame unless the ladder is fitted with a board at the top so that the applied load is safely distributed over the frame;
- w. Metal ladders shall not be used in the vicinity of live electrical equipment;
- x. Adequate means shall be provided to prevent displacement of the ladder set up in public thoroughfare or where persons, vehicles etc. may accidentally collide with it.

6.3. PORTABLE STEPLADDERS

- a. The length of portable stepladders shall not exceed 6 m and their back legs shall be adequately braced;
- b. Stepladders exceeding 1.5 m in length shall have two or more cross-ties;
- c. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
- d. When in the open position, treads of stepladders shall be horizontal.

6.4. PORTABLE TRESTLE LADDERS

- a. The height of the trestle ladders shall not exceed 5.5 m;
- b. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
- c. The front and back legs shall be joined at the top by bolted steel hinges of adequate dimensions or other effective means;
- d. Both legs of trestle ladders shall be equipped with sufficient number of steel crossties.

6.5. EXTENSION LADDERS

- a. The length of extension ladders shall not exceed 15 m;
- b. Extension ladders shall be equipped with an effective lock and guide brackets by which the ladder can be extended, retracted or locked in any position;

- c. The rungs of overlapping sections shall coincide so as to form double treads and shall be equipped with one or more extension ropes;
- d. Extension ropes shall be securely anchored and run over suitable pulleys.

6.6 MECHANICAL LADDERS

- a. Mechanical ladder is that ladder, which is a mechanically extendable ladder, mounted on a wheeled frame;
- b. Mechanical ladder shall be equipped with guard-rails and toe-boards and a cage of heavy-gauge steel mesh;
- c. If mechanical ladder has no railed platform or cage, workers using it shall be secured by suitable safety belt;
- d. Mechanical ladders shall not be moved, while a person is on them, unless they have specially designed to ensure that perfect stability is maintained during movement.

6.7. FIXED LADDERS

- a. Uprights of fixed ladders shall be at least 40 cm and shall be set an angle of 15° to the vertical;
- b. Clearance at the back of the rungs shall be at least 15 cm and no obstruction within 75 cm of the face of the ladder;
- c. There shall be at least 7.5 cm clearance between the ladder and the nearest fixed object;
- d. When it is necessary for a ladder to pass closely through a hole in a platform or a floor, the edges of the hole shall be padded so as to prevent injury to the users;
- e. The length of the runs of fixed ladder shall not exceed 9 m;
- f. Landing platform shall be provided for each 9 m or fraction thereof;
- g. As far as practicable, runs shall be staggered;
- h. Runs from which a person could fall from more than 6 m shall be enclosed in a cage of heavy-gauge mesh or hoops;
- i. Fixed ladders shall be firmly bolted or welded in position.

6.8. STAIRS

- a. Stairs shall be of adequate strength to withstand safely the loads that they will have to carry;
- b. Stairs used for the purpose of construction work shall have a clear width of at least 60 cm;
- c. Stairs made of perforated material shall not have openings exceeding 1.2 cm in width;
- d. No step of a stairway shall depend for its support solely on nails, spikes, screws or other similar fixing;
- e. No stairway with missing or dangerously defective steps shall be used;
- f. Every stairway that is at an angle of less than 30° from the vertical shall be provided with a secure handhold at the top landing place, either by extending one upright for at least 1 m or by other effective means;
- g. Movable and removable stairs shall be adequately secured in the position of use;
- h. In all building structures permanent stairs shall be constructed as soon as practicable;
- i. When work on a building has progressed to a height of more than 18 m above the ground and it has not been practical to construct the permanent stairs, sufficient number of stairs shall be provided to ensure safe access to the working levels.

7.0 SAFETY IN THE USE OF LIFTING APPLIANCES & GEARS

7.1. CONSTRUCTION AND MAINTENANCE OF LIFTING APPLIANCES:

All lifting appliances, including their parts and working gear, whether fixed or movable, and any plant or gear used in anchoring or fixing of such appliances -

- a. Shall be of sound construction, sound material, and of adequate strength to serve the purpose for which these are to be used and all such appliances shall be free from patent defects, and
- b. Maintained in good repair and working condition;
- c. Every drum or pulley around which the rope of any lifting appliance is carried, shall be of adequate diameter and sound construction in relation to such rope;
 - i. Any rope that terminates at the winding drum of lifting appliance shall be securely attached to such drum and at least three dead turns of such rope remain on such drum in every operating position of such lifting appliance;
 - ii. The flange of a drum projects twice the rope diameter beyond the last layer of such rope and if such rope and if such projection is not available, other measures like anti-slackness guards shall be provided to prevent such rope from coming off such drum;
- d. Every lifting appliance shall be provided with adequate and efficient brakes which shall be:
 - i) Capable of preventing fall of suspended load (including any test load),
 - ii) Effectively controlling such load while it is being lowered, acting without shock and shall be attached with shoes that can be easily removed for running and which shall be simple and have easily accessible means of adjustment;
- e. Provided that nothing contained above shall apply to **steam-winch** that can be operated as safely as with brakes.

7.2. CONTROLS OF EVERY LIFTING APPLIANCE SHALL BE SO;

- a. Situated that the driver of such appliance at his stand or seat has ample room for operating and has an unrestricted view of building or other construction work, as far as practicable, and that he remains clear of the load and the ropes, and that no load passes over him;
- b. Positioned with due regard to ergonomic considerations for proper operation of such appliance;
- c. Located that the driver of such appliance remains above the appliance and shall have upon them or adjacent to them clear markings to indicate their purpose and mode of operations;
- d. Provided, where necessary, with a suitable locking device to prevent accidental movement or displacement and shall move, as far as practicable, in the direction of the resultant load movement;
- e. Wherever automatic brakes are provided, they shall automatically come to the neutral position in case of power failure.

7.3. TEST AND PERIODICAL EXAMINATION

7.3.1 Test: all lifting appliances including all parts and gears thereof, whether fixed or movable, shall be tested and examined by a competent person before being taken into use for the first time or after it

has undergone any alteration or repairs liable to affect its strength or stability or after erection on a site and also once at least in every five years, in the manner as specified;

7.3.2. Examination: all lifting appliances shall be thoroughly examined by a competent person at least in every twelve months and where the competent person making such examination forms the opinion that the lifting appliance cannot continue to function safely, he shall forthwith give notice in writing of his opinion to the contractor.

7.4. AUTOMATIC LOAD INDICATOR

- a. Cut-out shall be provided which automatically arrests the movement of the lifting parts of every crane if the load exceeds the safe working load, wherever possible;
- b. Wherever the above provisions cannot be applied and if it is not possible to install an automatic safe load indicator, in that case, provision of a table showing the safe working loads at the corresponding inclinations or radii of the jib on the crane shall be considered sufficient.

7.5. INSTALLATION:

Fixed lifting appliances shall be installed by a competent person in a manner that

- a. Such appliances cannot be displaced by the load, vibration or other influences;
- b. The operator of such appliance is not exposed to danger from loads, ropes or drums;
- c. The operator can either see over the zone of operation or communicate with all loading and unloading points by signal, or other communication system;
- d. Adequate clearance is provided between parts or loads of lifting appliances and between the fixed objects such as walls and posts, or electrical conductors;
- e. The lifting appliances; when exposed to wind loading, are given sufficient additional strength, stability and rigidity to withstand such loading safely;
- f. No structural alterations or repairs are made on any part of the lifting appliances that affect the safety of such appliances without obtaining the opinion of the competent person to this effect.

7.6. WINCHES

- a. Winches shall not be used if their control levers operate with excessive friction or play;
- b. Double gear winches shall not be used unless a positive means of locking the gearshift is provided;
- c. There shall be no load other than the fall and the hook assembly on the winch while changing gears on a two-gear winch;
- d. Adequate protection shall be provided to the winch operator against abnormal weather;

- e. Temporary seats or shelters for winch operators that may pose hazard to the winch operator or any other building workers shall not be allowed to be used;
- f. Control levers shall be secured in the neutral position and, whenever possible, the power shall shut off if the winch is left unattended.

7.7. IN USE OF EVERY STEAM-WINCH

- a. Measures shall be taken to prevent escaping steam from obscuring any part of the construction site or other workplace or from otherwise hindering or injuring any building worker;
- b. Extension control levers which tend to fall off their own weight shall be counter-balanced;
- c. Winch operators shall not be permitted to use the which control extension levers except for short handles on wheel type controls and that such levers shall be of adequate strength, secure and fastened with metal connections at the fulcrum and at the permanent control lever;
- d. In use of every electric winch, no building worker shall be permitted to transfer, alter or adjust electric control circuits in case of any defect in such winch;

7.8. ELECTRIC WINCHES SHALL NOT BE USED FOR BUILDING WORK WHERE

- a. The electromagnetic brake is unable to hold the load; or
- b. One or more control points either hoisting or lowering are not operating properly.

7.9. BUCKETS:

It shall be ensured that tip-up buckets are equipped with a device that effectively prevents accidental tipping.

7.10. IDENTIFICATION AND MARKING OF SAFE WORKING LOAD:

- a. Every lifting appliance and loose gear shall be clearly marked for its safe working load and identification by stamping or other suitable means;
- b. Every derrick (**other than derrick crane**) shall be clearly marked for its safe working load when such derrick is used either in single purchase with lower block or in union purchases in all possible block positions;
- c. The lowest angle to the horizontal, to which the derrick may be used, shall be legibly marked;
- d. Every lifting appliance having more than one working load shall be fitted with effective means to enable the operator to determine safe working load at each point under all conditions of use;
- e. Means to ascertain the safe working load for lifting gears under such conditions in which such gears may be used shall be provided to enable a worker using such gears and such means safely, which shall comprise:
 - i) Marking of the safe working load in plain figures or letters upon the sling or upon a tablet or ring of durable material attached securely thereto in case of chain slings; and

- ii) The means specified or notices so exhibited as can be easily read by any concerned building worker stating the safe working load for the various sizes of the wire rope slings used.

7.11 LOADING OF LIFTING APPLIANCES AND LIFTING GEARS

- a. No lifting appliance, lifting gear or wire rope shall be used in an unsafe way and in such a manner as to involve risk to life of building workers and they are not loaded beyond their safe working load except for testing purposes under the direction of a **competent person** in the manner as specified in schedule;
- b. No lifting appliance and lifting gear, or any other material-handling appliance shall be used if the Inspector having jurisdiction under the Building and Other construction (regulation of employment and conditions of service) Act/Rules is not satisfied with reference to a certificate of test or examination or to an authenticated record maintained as provided under the Rules or if in his view the lifting appliance, lifting gear or any other material handling appliance is not safe for use in building or other construction work;
- c. No pulley block shall be used unless the safe working load and its identification are clearly marked on such block.

7.12. OPERATOR'S CAB OR CABIN SHALL

- a. Be made of fire resistant material;
- b. Have a suitable seat, a foot rest and protection from vibration;
- c. Afford the operator an adequate view of the area of operation;
- d. Afford the necessary access to working parts in the cab;
- e. Afford the operator adequate protection against the weather;
- f. Be adequately ventilated; and
- g. Be provided with a suitable fire extinguisher.

7.13. OPERATION OF LIFTING APPLIANCES:

Operator of every crane or lifting appliance shall possess adequate skill and training in the operation of the particular lifting appliances, provided further that

- a. No person under eighteen years of age shall be in control of any lifting machine, scaffold winch, or give signals to the operator;
- b. Precaution shall be taken by the trained operator to prevent lifting appliance from being set in motion inadvertently;
- c. The operation of lifting appliances shall be governed by signals in conformity with the approved standards;
- d. The operator's attention shall not be distracted while he is working;
- e. No crane, hoist, winch or other lifting appliance or any part of such crane, hoist, winch or other lifting appliance shall, except for testing purposes, be loaded beyond the safe working load;
- f. During the hoisting operation, effective precaution shall be taken to prevent any person from standing or passing under the load in such operation;

- g. Operator shall not leave lifting appliance unattended while power is on or the load is suspended to such appliance;
- h. No person shall ride on a suspended load of any lifting appliance;
- i. Every part of a load in course of being hoisted or lowered shall be adequately suspended and supported to prevent danger;
- j. Every receptacle used for hoisting bricks, tiles, slates or other material shall be suitably enclosed as to prevent the fall of any such material;
- k. The hoisting platform shall be enclosed when loose material or loaded wheel barrows are placed directly on such platform or lowering such materials or wheel barrows;
- l. No material shall be raised, lowered or slewed with any lifting appliance in such a way as to cause sudden jerks to such appliance;
- m. In hoisting a barrow, any wheel of such barrow shall not be used as a means of support unless adequate steps have been taken to prevent the axle of such wheel from slipping out of its bearing;
- n. Long objects like planks or girders shall be provided with tag line to prevent any possibility of danger while raising or lowering such objects;
- o. During the process of landing or material, a building worker shall not be permitted to lean out into empty space for finding out the loading and unloading of such material;
- p. When hoisting of load is done in an enclosed space, neither the lifting material nor the boom shall project outside the enclosed space;
- q. Adequate steps shall be taken to prevent a load, in the course of being hoisted or lowered from coming into contact with any object to avoid any displacement of such load and appropriate appliances provided and used for guiding heavy loads when raising or lowering heavy loads to avoid crushing of hands of building workers during such raising or lowering of loads.

7.14. HOISTS

- a. Hoist towers shall be designed according to the relevant national standards;
- b. Hoist shafts shall be provided with rigid panels or other adequate fencing at the ground level on all sides of such shafts and at all other levels on all sides of the access to such shafts while the walls of hoist shafts, except at approaches, extend at least two meters above the floor or platform of access to such shafts;
- c. Approaches to hoist shall be adequately lit and provided with gates that shall be guarded to maintain visibility at least of two meters height; and equipped with a device, which requires such gate to be closed before the platform of such hoist can leave the landing, and prevents the gate from being opened unless such platform is at the landing;
- d. The guides of hoist platforms shall offer sufficient resistance to bending and to bucking in the case of jamming, by providing a safety catch;
- e. Overhead beams and their supports are capable of holding the total maximum live and dead loads that such beams and supports will be required to carry, with a safety factor of at least five;

- f. A clear space shall be provided –
- i. Above the highest stopping place of a cage or platform to allow sufficient unobstructed travel of such cage or platform in case of over-winding and
 - ii. Below the lowest stopping place of such cage or platform;
- g. Adequate covering shall be provided above the top of hoist shafts to prevent materials from falling into such shafts;
- h. Outdoor hoist towers shall be erected on adequately firm foundations and securely braced, guyed and anchored;
- i. A ladder way shall extend from the bottom to the top of every outdoor hoist tower in case no other ladder way exists within easy reach and such ladder way shall comply with the relevant national standards;
- j. The rated capacity of a hoisting engine shall at least be one and a half times the maximum load that such engine will be required to move;
- k. All gearing on a hoisting engine shall be securely enclosed;
- l. Steam piping of hoisting engine shall be adequately protected against accidental contact of such piping with a building worker;
- m. Electrical equipment of a hoisting engine shall be effectively earthed;
- n. A hoist shall be provided with suitable devices to stop a hoisting engine as soon as the platform of such hoist reaches its highest stopping place;
- o. A hoisting engine shall be protected by suitable cover against weather and falling objects;
- p. A hoisting engine set up in a public thoroughfare shall be completely enclosed;
- q. All exhaust steam pipes shall discharge steam in such a manner that the steam so discharged does not scald any person or obstruct the operator's view;
- r. The motion of a hoist shall not be reversed without first bringing it to rest to avoid any harm from such reverse motion;
- s. A hoist not designed for the conveyance of persons shall not be set in motion from the platform of such hoist;
- t. Pawls and ratchet wheels of a hoist, requiring disengagement of such pawls from such ratchet wheels, before the platform of such hoist is lowered, shall not be used;
- u. A platform of a hoist shall be capable of supporting such maximum load that such platform may carry with a safety factor of at least three;
- v. A platform of a hoist shall be equipped with suitable safety gear which can hold such platform with its maximum load in case its hoisting rope breaks;
- w. On platform of a hoist, the wheel barrows or truck shall be efficiently blocked in safe positions;

- x. A cage of a hoist or platform where the building workers are required to enter into such cage or to go on such platform at landing levels, shall be provided with a locking arrangement to prevent such cage or platform from moving during the time a worker enters or leaves such cage or platform;
- y. The sides of platform of a hoist which are not used for loading or unloading, shall be provided with toe-board and enclosures of a wire mesh or any other suitable means to prevent the fall of any part of a load from such platform, further provided that
 - i. The platform of a hoist, which has any probability of falling of any part of a load from it, shall be provided with an adequate covering to prevent such fall;
 - ii. The counter weights of a hoist consisting of an assemblage of several parts shall be so constructed that such parts shall be rigidly connected together;
 - iii. The counter weights of a hoist shall run between guides;
 - iv. At every level of work the building workers shall be provided with adequate platforms for performing such work;
 - v. A legible notice in Hindi as well as in a local language shall be displayed in a conspicuous place of the platform of a hoist and that such notice shall state the maximum carrying capacity of such hoist in kilograms on the hoisting engine;
 - vi. On a hoist authorized and certified for the conveyance of the persons on the platform or in the cage and such notice shall state the maximum number of persons to be carried on such hoist at one time;
 - vii. On a hoist carrying goods and other materials such notice shall state that such hoist is not meant for carriage of persons.

7.15. FENCING AND MEANS OF ACCESS TO LIFTING APPLIANCES

- a. Safe means of access shall be provided to every part of lifting appliances;
- b. The operator's platform on every crane or tip driven by mechanical power shall be securely fenced and provided with safe means of access and where access to such platform is by a ladder, the sides of such ladder shall extend to a height reasonable beyond such platform or some other suitable handhold shall be provided in the platform;
- c. The handling place on such platform shall be maintained free from obstruction and slipping; and
- d. In case the height of such ladder exceeds six meters, the resting platforms shall be provided on such ladder at every six meters of its height and where the distance between last platform so provided and the top end of such ladder is more than two meters then on such top end.

7.16. RIGGING OF DERRICKS:

Every derrick shall have current and relevant rigging plans and any other information necessary for the safe rigging of such derrick and its gear.

7.17. SECURING OF DERRICK FOOT:

Appropriate measures shall be taken to prevent the foot of a derrick from being lifted out of its socket or supports.

7.18. CONSTRUCTION AND MAINTENANCE OF LIFTING GEAR

- a. Every lifting gear shall be –
 - i. of good design and construction, sound material and adequate strength to perform the work for which it is used;
 - ii. free from patent defects; and
 - iii. properly maintained in good repair and working order;
- b. Components of the loose gear, at the time of its use, shall be renewed if one of its dimensions at any point has decreased by ten per cent or more;
- c. A chain shall be withdrawn from use when it is stretched and increased in length which exceeds five per cent of its length or when a link of such chain is deformed or is otherwise damaged or defects in the welds have appeared on it;
- d. Rings, hooks, swivels and end links attached to a chain shall be of the same materials as that of such chain;
- e. The voltage of electric supply to any magnetic lifting device shall not fluctuate by more than **plus** or **minus** 10%.

7.19. TEST AND PERIODICAL EXAMINATION OF LIFTING GEARS

- a. A lifting gear shall be initially tested for the manufacturer by a competent person in a manner specified as per schedule annexed before taking into use or after undergoing any substantive alterations which renders its any part liable to affect its safety and such gear after such test shall subsequently be retested for the use of its owner at least once in every five years;
- b. A lifting gear in use shall thoroughly examined once at least in every twelve months by a competent person;
- c. A chain in use shall be thoroughly examined at least once every month by a responsible person for its use;
- d. Certificates of initial and periodical test and examinations of loose gears shall be obtained in the form annexed.

7.20. ROPES

- a. No rope shall be used for building or other construction work unless -
 - i) It is of good quality and free from patent defects; and
 - ii) In the case of wire rope, it shall be tested and examined by a competent person in the manner annexed;
 - iii) Every wire rope of lifting appliance or lifting gear used for building or other construction work shall be inspected by a responsible person for such use, once at least in every three month;

- b. Provided that after if any such wire is broken in such rope, the responsible person shall thereafter inspect it once at least in every month and ensure that;
- c. No wire rope shall be used for building or other constructing work if in any length of eight diameters of such wires, the total number of visible broken wires exceed ten per cent of the total number of wires in such rope, or such rope shows signs of excessive wear, corrosion or other defects which in the opinion of the person who inspects it, is unfit for use;
- d. Eye splices and loops of ropes for the attachment of hooks, rings and other such parts to wire rope shall be made with suitable thimble;
- e. A thimble or loop splice made in any wire rope sling shall conform to the following standards, namely:
 - i) Wire rope sling shall have at least three tucks with full strand of rope and two tucks with one-half of the wires cut out of each of such strand in all cases, such strands shall be tucked against the lay of the rope;
 - ii) Protruding ends of such strands in any splice of wire rope slings shall be covered or treated so as to leave no sharp points;
 - iii) A fiber rope or a rope sling shall have at least four tucks, tail of such tuck being whipped in a suitable manner; and
 - iv) A synthetic fiber rope or rope sling shall have at least four tucks with full strands followed by further tuck with one-half filaments cut out of each of such strand and final tuck with one-half of the remaining filaments cut out from such strands. Any portion of the splices containing such tucks, with reduced number of filaments, shall be securely covered with suitable tape or other materials;
 - v) Provided further that nothing contained above shall apply where any other form of splice, which may be shown to be as efficient as the splice with above standards, shall be used.

7.21. HEAT TREATMENT OF LIFTING GEARS

- a. All chains other than bridle chains attached to derricks and all rings, hooks, shackles and swivels used in hoisting or lowering of such derricks shall be effectively annealed under supervision of a competent person and at the following intervals, namely:
 - i) Such chains, rings, hoods, shackles and swivels which are not more than twelve and a half millimeter of length annealed at least once in every six months; and
 - ii) All other such chains rings hooks shackles and swivels shall be so annealed at least once in every twelve months;
- b. Provided that the clause (a) above shall not apply to -
 - i) Pitched chins, working on sprocket or sprocket wheels;
 - ii) Rings, hooks and swivels permanently attached to pitched chains, pulley blocks or weighing machines, and
 - iii) Hooks and swivels having ball bearings or other case hardened parts;

- c. A chain or a loose gear made of high tensile steel or alloy steel shall be plainly marked with a mark indicating that it is so made;
- d. No chain or loose gear made of high tensile steel or alloy steel shall be subjected to any form of heat treatment except where such treatment is necessary for the purpose of repair of such chain or loose gear and that such repair shall be made under the direction of the competent person;
- e. That the wrought iron gear, the past history of which is not traceable, shall be suspected of being heat treated at incorrect temperature shall be normalized before using it on any building or other construction work.

7.22. CERTIFICATE TO BE ISSUED AFTER ACTUAL TESTING AND EXAMINATION ETC:

A competent person shall issue a certificate after actual testing or examination of the apparatus specified and record of such test or examination shall be maintained for inspection.

7.23. REGISTER OF PERIODICAL TEST, EXAMINATION AND CERTIFICATION THEREOF

- a. A register in the form annexed shall be maintained and particulars of such test and examination of lifting appliances, lifting gears and heat treatment as required shall be entered in such register;
- b. Certificate in respect of each of the following shall be obtained from a competent person:
 - i) In cases of initial and periodical test and examination of the lifting appliances such as Winches, Derricks and their accessory gears, Cranes or Hoists and their accessory gears;
 - (ii) In case of test, examination and re-examination of loose gears;
 - (iii) In case of test and examination of wire ropes;
 - (iv) In case of heat treatment and examination of loose gears;
 - (v) In case of annual thorough examination of the loose gears, except where required particulars of such exemption have been enclosed in the register referred to in Form annexed and such certificates are attached to the register referred to as above and certificates kept at such construction site in case such register and certificate relate to lifting appliances, loose gear and wire ropes and
- c. Produced on demand and retained for at least five years after the date of the last entry made in such register;
- d. No lifting appliance or lifting gear in respect of which an entry is required to be made in register referred to above and certificate of test and examination are required to be attached in such register in the manner as specified, shall be used for building or other construction work unless the required entries have been made in such register and certificates.

7.24. VACUUM AND MAGNETIC LIFTING GEAR

- a. No vacuum lifting gear, magnetic lifting gear or any other lifting gear where the load on it is held by adhesive power, shall be used while workers are performing operations beneath such gear;
- b. A magnetic lifting gear used in connection with building or other construction work shall be provided with an alternative supply of power, such as batteries, which may come into operation immediately in the event of failure of the main power supply;

- c. No building worker shall work within the swinging zone of the lifting gear or load or building or other construction material suspended to such lifting gear.

7.25. KNOTTING OF CHAINS AND WIRE ROPES:

No chain or wire rope with a knot in it shall be used in building or other construction work.

7.26. CARRYING OF PERSONS BY MEANS OF LIFTING APPLIANCES ETC.

- a. No building worker shall be raised, lowered or carried by a power driven lifting appliance, except
 - i. On the drive's platform in the cage of a crane; or
 - ii. On as hoist; or
 - iii. On an approved suspended scaffold;
- b. Provided that a building worker may be raised, lowered or carried by a power driven lifting appliance:
 - i. In circumstances where the use of a hoist or of a suspended scaffold shall not reasonably be practicable, or
 - ii. On an aerial cableway or aerial ropeway, provided further that the following requirements are met:
 - iii. That the appliance referred to above can be operated from one position only and that
 - iv. Any winch used in connection with the appliance shall also comply with the requirements as laid down above.
- c. The appliance referred to above shall not carry any person except:
 - i. In a chair or cage,
 - ii. In a skip or other receptacle at least three feet deep which shall be suitable for safe carriage of a person and any such chair, cage, skip or other receptacle shall be made of good construction, sound material, and adequate strength and properly maintained with suitable means to prevent any occupant therein from falling out of it and shall be free from any material or tools which may interfere with the handhold or foothold of such occupant or otherwise endanger him; and
 - iii. Those suitable measures shall be taken to prevent the chair, cage skip or other receptacle from spinning or tipping in a manner dangerous to any occupant therein.

7.27. HOISTS CARRYING PERSONS

- a. No building worker shall be carried with the help of a hoist unless it is provided with a cage which:
 - i) Is so constructed as to prevent, when its gates are shut, any building worker carried by such hoist from falling out of it or from being trapped between any part of such cage and any fixed structure or other moving part of such hoist or from being struck by articles or materials falling down the hoist way on which such hoist is moving; and
 - ii) Is fitted on each of its side from which access is provided to a landing place with a gate which has efficient interlocking or other devices to secure so that such gate cannot be opened except when such cage is at a landing place and that such cage cannot be moved away from any such place until such gate is closed;

- b. Every gate in the hoist way enclosure of such hoist used for carrying persons shall be fitted with efficient interlocking or other devices to secure so that such gate cannot be opened except when the cage of such gate is at the landing place and that such cage cannot be moved away from the landing place until such gate is closed;
- c. In every hoist used for carrying building workers there are provided with suitable and efficient automatic devices to ensure that the cage of such hoist comes to rest at a point above the lowest point to which such cage may travel.

7.28. ATTACHMENT OF LOADS

- a. When a sling is used to hoist long materials, a lifting beam shall be used to space the sling legs for proper balance and when a load is suspended at two or more points with slings, the eyes of the lifting legs of such slings shall be shackled together and such shackled eyes of the shackled slings shall be placed on the hook or the eyes of such lifting legs shall be shackled directly to the hoisting block, ball or balance beam, as the case may be;
- b. Every container or receptacle used for raising or lowering stone, bricks tiles, slates or other similar objects shall be so enclosed with the hoist as to prevent the fall of such objects;
- c. A loaded wheel barrows placed directly on a platform of a hoist for raising or lowering of such wheel barrows shall be so secured that such wheel barrows cannot move and such platform shall be enclosed to prevent the fall of the contents kept in such wheel barrows;
- d. Landings of hoists shall be so designed and arranged that building workers on such hoist be not required to lean out into empty space for loading and unloading on any material from such hoist

7.29. TOWER CRANES

- a. No person other than the operator trained and capable to work at heights shall be employed to operate tower cranes;
- b. The ground on which a tower crane stands shall have adequate bearing capacity;
- c. Bases for tower cranes and trucks for rail mounted tower cranes shall be firm and leveled and such cranes erected at a reasonably safe distance from excavations and operated within gradient limits as specified by the manufacturer of such cranes;
- d. Tower cranes shall be sited where there is a clear space available for erection, operation and dismantling of such cranes;
- e. Tower cranes shall be sited in such a way that the loads on such cranes shall not be handled over any occupied premises, public thoroughfares, railways or near power cables, other than construction works for which such cranes are used;
- f. Where two or more tower cranes are sited and operated, every care shall be taken to ensure positive and proper communication between operators of such cranes to avoid any danger or dangerous occurrences;
- g. Tower cranes shall not be used for loading magnet, or demolition ball service, piling operation or other similar operations which could impose excessive load stresses on the crane structure of such cranes;

- h. The instruction of the manufacturer of a tower crane and standard safe practices regarding such cranes shall be followed while operating or using such cranes.

7.30. QUALIFICATION OF OPERATOR OF LIFTING WINCHES AND OF SIGNALER ETC.

- a. No person shall be employed to drive or operate a lifting appliance whether driven by mechanical power or otherwise or to give signals to driver of operator of such lifting appliance or to work as an operator of a rigger or derricks unless he is
 - i) Sufficiently competent and reliable;
 - ii) Possesses the knowledge of the inherent risks involved in the operation of lifting appliance;
 - iii) Medically examined periodically as specified and
 - iv) Is above eighteen years of age.

8.0 SAFETY IN THE USE OF TRANSPORT, EARTHMOVING EQUIPMENT & OTHER CONSTRUCTION MACHINERY

8.1 EARTHMOVING EQUIPMENT AND VEHICLES

- a. All vehicles and earthmoving equipment shall be made of good material, proper design and sound construction and be sufficiently strong for the purpose for which such equipment are properly used in accordance with standard safe operating practices;
- b. Provided that the truck or trailer employed for transporting freight containers shall be of the size sufficient to carry the containers, without over hanging and provided with twist locks conforming to approved standards, at all the four corners of each of such use by an authority under the relevant law for the time being in force and is inspected by a responsible person, at least once in a month and record of such inspection shall be maintained:
- c. All transport or earth moving equipment and vehicles shall be inspected at least once a week by a responsible person and in case any defect is noticed in such equipment or vehicle it shall be immediately taken out of use;
- d. Power trucks and tractors shall be equipped with effective brakes, headlights and tail lamps and maintained in good repair and working order;
- e. Side stanchions on power trucks and trailers for carrying heavy and long objects shall be
 - i. Of sound construction and free from defects;
 - ii. Provided with tie chains attached to the top across the loads for preventing such stanchions from spreading out; and
 - iii. Kept in position while loading and unloading;
 - iv. Safe gangways provided for to and fro movement of building workers engaged in loading and unloading of lorries, trucks, trailers and wagons;
 - v. Trucks and other equipment shall not be loaded beyond their safe capacity and carry workers engaged in loading and unloading of lorries, trucks trailers and wagons in an unsafe condition;
 - vi. Handles of trucks shall be so designed as to protect the hands of the building workers working on such trucks, or such handles provided with knuckle guards;
 - vii. No unauthorized person shall ride the transport equipment employed in such work;
 - viii. A driver of a transport equipment shall maneuver such equipment under the direction of a signaler;
 - ix. Adequate precaution such as isolating the electric supply or erecting overhead barriers of a safe height shall be taken when earth moving equipment or vehicles are required to operate in dangerous proximity to any live electric conductor;
 - x. Vehicles and earth moving equipment shall not be left on a slope with the engine of such vehicles or equipment running;

- xi. All earth moving equipment, vehicles or other transport equipment shall be operated only by such person who are adequately trained and possess such skills as required for safe operation of such equipment, vehicle or other transport equipment.

8.2. POWER SHOVELS AND EXCAVATOR

- a. A shovel or an excavator whether operated by steam or electric or by internal combustion, shall be constructed, installed, operated, tested and examined as per approved standards;
- b. Excavator equipped for use as a mobile crane shall be examined and tested in accordance with the requirements for such mobile cranes as laid down by the manufacturer; and
- c. Fitted with an automatic safe working load indicator;
- d. Buckets or grabs of power shovels shall be propped to restrict the movement of such buckets or grabs while being repaired or while the teeth of such buckets or grabs are being changed.

8.3. BULLDOZER

- a. Operator of every such bulldozer before leaving the dozer shall take the following steps:
 - i) Apply the brakes;
 - ii) Lower the blade and sipper and
 - iii) Put the shift lever into neutral;
 - iv) Dozer left on level ground at the close of the work for which such bulldozer is used;
 - v) The blade of a bulldozer kept low when such bulldozer is moving uphill;
 - vi) The bulldozer blades not used as brakes except in an emergency.

8.4. SCRAPERS

- a. A tractor and scraper shall be joined by safety line at the time of its operation;
- b. The scraper bowls shall be propped while blades of such scraper are being replaced;
- c. A scraper moving downhill shall not be left in gear.

8.5. MOBILE ASPHALT LAYERS & FINISHERS

- a. A mixture elevator shall be located within a wooden or sheet metal enclosure with a window for observation, lubrication and maintenance;
- b. Bitumen scoops shall have adequate covers;
- c. When asphalt plants are working on public road, adequate traffic control shall be established on such road and the building workers working with such plant provided with reflective jackets;
- d. A sufficient number of fire extinguishers shall be kept in readiness at such workplace where fire hazards may exist;
- e. The materials shall be loaded on the elevator after the drying drain has warmed up of such elevator;
- f. No open light shall be used for ascertaining the level of asphalt;

- g. Inspection opening shall not be opened till there is a pressure in the boiler, which may cause injury to building workers.

8.6. PAVERS:

Pavers shall be equipped with guards suitable to prevent building workers from walking under the skip of such pavers.

- 8.7. Road rollers:** Before a road roller is used on the ground, such ground shall be examined for its bearing capacity and general safety, especially at the edges of slopes such as embankment on such grounds and shall not be moved downhill with the engine out of gear.

8.8. GENERAL SAFETY IN RESPECT OF POWERED CONSTRUCTION MACHINERY

- a. Every vehicle or earthmoving equipment shall be equipped with -
 - i) Silencers;
 - ii) Tail lights
 - iii) Power and hand brakes;
 - iv) Reversing alarm; and
 - v) Search light for forward and backward movement, which are required for safe operation of such vehicle or earthmoving equipment;
- b. The cab of vehicle or earthmoving equipment shall be kept at least one meter from the adjacent face of a ground being excavated;
- c. When cranes or shovel are traveling, the boom of such crane or shovel shall be in the direction of such travel and the bucket or scoop attached to such crane or shovel raised and without load except when such traveling is downhill.

9.0 SAFETY IN THE PROVISION OF RUNWAYS AND RAMP

9.1. USE OF RUNWAYS AND RAMPS:

- a. Runway or ramps shall not be less than 430 mm in width and constructed of not less than 25 mm thick planking or any other material of adequate strength to withstand the required load, supported substantially in relation to the span and braced with such runway or ramp, and design and construction of such runway or ramp shall be in accordance with the approved standards;
- b. Every runway or ramp located more than 3 m above the floor or ground shall be on open sides and provided with a guardrail of adequate strength and height of not less than 1 m.
- c. Use of runways and ramps by vehicles:
 - i. All runways and ramps shall be of sound construction, strength and securely braced and supported;
 - ii. Every runway or ramp for the use of transport equipment like trailers, trucks or heavier vehicles shall have a width of not less than 3.7 m and provide with timber curbs or any other material of adequate strength with not less than 200 mm by 200 mm in width placed parallel to, and secured to, the sided of such runway or ramp and such runways or ramps or ramps shall be designed in accordance with the approved standards.

9.2. SLOPE OF RAMPS:

Every ramp shall have a slope not exceeding one in four and the total rise of a continuous ramp used by building workers carrying material or using wheelbarrows shall not exceed 3.7 m, unless broken by horizontal landing of at least 1.2 m in length.

9.3. USE OF RUNWAYS OR RAMPS BY WHEELBARROWS, ETC.

- a. Every runway or ramp used for wheelbarrows and carts or hand trucks shall not be less than 1 m width and constructed of not less than 50 mm thick planking, and supported and braced suitably for such use;
- b. Every runway or ramp located more than 3 m above the floor or ground shall be provided on the open sides with suitable guardrails of adequate strength.

10. SAFETY IN HANDLING AND USE OF EXPLOSIVES

10.1 GENERAL PROVISIONS:

- a. The use of explosives shall be carried out in a safe manner to avoid injury to any person and under the direct supervision of a responsible person;
- b. No person other than authorized and competent one shall be allowed to handle and use explosives;
- c. Before using any explosive, necessary warning and danger signals shall be erected, at conspicuous places of such use to warn the building workers and the general public of the danger involved in such use.
- d. No person other than authorized and competent one shall be allowed to handle and use explosives.
- e. Smoke, open lamps, other type of hot or heat producing items and sparks shall be prohibited in or near explosives magazines or while explosives are being handled, transported or used.
- f. No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors or dangerous drugs.
- g. The explosives shall be accounted for at all times. No explosives or blasting agents shall be abandoned.
- h. No fire shall be fought where the fire is in the imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area shall be guarded against intruders.
- i. Employees authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution including but not limited to visual and audible warning signals, flags, or barricades to ensure employee safety.
- j. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity or otherwise. These precautions shall include:
- k. Short-circuiting of detonators in holes, which have been primed and shunted until wired into the blasting circuit.
- l. The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.
- m. The prominent display of adequate signs, warning against the use of radio transmitters, on all roads within 1000 ft of blasting operations. Whenever adherence to the 1000 ft distance would create an operational handicap, a competent and expert person shall be consulted to evaluate the particular situation, and an alternative provided, which are adequately designed to prevent any premature firing of electric blasting of caps. A description of any such blasting shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for inspection.

- n. Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.
- o. Explosives, blasting agents and blasting supplies that are obviously deteriorated or damaged shall not be used.
- p. Delivery and issue of explosives shall only be made authorized persons into authorized magazines or approved temporary storage or handling areas.
- q. Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken. In such situations controlled blasting shall be restored to.
- r. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.
- s. Loaded boreholes shall not be left unattended after the end of the shift.
- t. Suitable and sufficient means of egress to ground level shall be provided in all cases of excavations, trenches, all other places where explosives are handled above or below ground level.
- u. At an appropriate time before the final blasting warnings, workers in the area shall be removed to a designated safe place.
- v. An unmistakable, audible, final warning shall be sounded one minute prior to the detonation of explosives; after completion, when the person in charge has established that safe conditions prevail, an "all clear" shall be sounded.
- w. To prevent persons entering any danger zone during blasting operations notices shall be given to all concerned.
- x. Notices referred above shall indicate:
 - i. that explosives are in use;
 - ii. the audible warning sound and the "all clear" and state when they will be sounded; and
 - iii. the warning flags in use, including an "all clear" flag.
- y. Precautions against lightning shall be provided in accordance with the Indian Electricity Act and Indian Explosives Act and Rules and regulations framed there under.
- z. Package containing explosives shall not be dragged, dropped or handled roughly.
- aa. Non-sparking tools shall be used to open keys.
- bb. The explosives shall not be carried in the box or otherwise on any individual.
- cc. Nothing shall be inserted in the open end of the blasting cap except fuses.

dd. Deteriorated or damaged explosives shall not be used but shall be disposed or destroyed strictly in accordance with the approved methods and in the doing so the manufacturers or the appropriate authority's instructions shall be followed.

ee. lightning shall be in accordance with Indian Electricity Act/Rules

10.2. TRANSPORTATION OF EXPLOSIVES

- a. Keep safe distance and to use non-sparking tools while opening packages containing explosives;
- b. Stop the use of explosives and handling thereof while the weather conditions are not suitable for such use or handling;
- c. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power-lines, dust storms or other sources of extraneous electricity or otherwise. These precautions shall include –
 - i. Suspension of all blasting operations and evacuation of persons;
 - ii. All warning signs shall be displayed within 200 m of blasting operations and in case putting up a sign at 200 m is impractical, the contractor shall consult the Engineer-in-charge for alternatives;
 - iii. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in the field;
 - iv. To prevent persons entering any danger zone during blasting operations, notices shall be given to all concerned;
- d. In addition to these provisions, all measures and precautions that are required to be observed for use, handling, storing or transportation of explosives under the Rules framed under the Explosives Act, 1884 (4 of 1884) shall be observed;
- e. All the relevant statutory provisions, local laws and rules and regulations shall be complied with.
- f. Where the magazine is located near the construction site and blasting operation continues daily, actual requirement of explosives shall be drawn from the magazine and transported to the site. Any leftovers shall be returned to the magazine each time after the blast. In case of work at scattered places and for a small duration, portable magazines shall be used and kept within a fence in safe place and properly guarded.
- g. For carrying higher quantity (more than 5 kg of explosives) specially designed insulated containers shall be used. These containers shall be constructed of finished wood not less than 5cm thick or plastic not less than 6mm thick or pressed fibre not less than 10mm thick. There shall be no metal parts (not even nails, bolts, screws etc.) and the containers shall be provided with suitable non-conductive carrying device, such as rubber, leather or canvas handle or strap.
- h. Vehicles to be used for transportation explosives shall be in good working condition and shall have a tight wooded or non-sparking metal (copper, brass and the like) floor with sides and

ends high enough to prevent the explosives from falling off the vehicle. In open bodied vehicles, the explosives shall be covered with a waterproof and fibre tarpaulin.

- i. Electrical wiring in vehicle shall be fully insulated so as to prevent the danger of short-circuiting and at least two fire extinguishers of carbon dioxide type shall be carried. The vehicle shall be properly marked indicating adequate warning to the public in regard to the nature of cargo.
- j. No metals except approved metal truck shall be allowed to come in contact with cases of explosives, metal, flammable, or corrosive substance shall not be transported with explosives. As far as possible, transportation of any material along with explosives shall be prohibited.
- k. Smoking shall be prohibited in the vehicle carrying explosives.
- l. No unauthorized person shall be allowed in the vehicle, carrying explosives.
- m. Loading and unloading of explosives shall be done carefully.
- n. Explosives and detonators or blasting caps shall not be permitted to be transported in the same vehicle.
- o. Detonators and other explosives for blasting shall be transported to the site of work in the original containers or in securely locked separate non-metallic containers and shall not be carried loose or mixed with other materials.

10.3. STORAGE OF EXPLOSIVES AND BLASTING AGENTS

- a. Explosives and related materials shall be stored in approved facilities.
- b. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents.
- c. Smoking and open flames shall not be permitted within 50 feet of explosives and detonators storage magazine.
- d. No Explosives or blasting agents shall be permanently stored in any underground area until the area has been developed to the point where at least two modes of exit have been provided.
- e. Permanent underground storage magazine shall be at least 300 feet from any shaft or other active underground working area.
- f. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.

10.4. DRILLING AND LOADING

- a. Before planning out the drilling operations for blasting purposes, nature of stratum and the overburden shall necessarily be examined to avoid possibilities of landslides after blasting.
- b. The face or rock shall be carefully examined before drilling to determine the presence of unfired explosives. No attempt shall be made to drill at a site if un-detonated explosives are suspected. In such case the boreholes shall be thoroughly cleaned before a cartridge is

- inserted. Wooden tamping rods (not pointed, but cylindrical throughout) shall be used in the charging the holes. The cartridge will be on the top.
- c. The borehole shall be carefully checked for length, presence of water dust, etc. with a wooden temping pole or a measuring tape before loading.
 - d. Surplus explosives shall not be stacked near working areas during loading/unloading.
 - e. The line of detonating fuse extending into a borehole shall be cut from the spool before loading the remainder of the charge.
 - f. A bore shall not be loaded with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making sure it is cool and it does not contain any hot smoldering material. Temperatures in excess of 65° C are dangerous.
 - g. A bore near another hole loaded with explosives shall not be sprung.
 - h. No force shall be used for inserting cartridges or any explosives into a bore hold or pass any obstruction in a borehole.
 - i. No force shall be used for inserting a blasting cap or an electric blasting cap into explosive. The cap shall be inserted into a hole made with a pickers designed for the purpose. A hitch of the electric blasting cap leading wire shall be made on the primer cartridge so as to prevent pulling out the electric blasting cap from the explosive charge. In case of fuse, the fuse shall be tied to the explosive cartridge so that the blasting cap is not pulled out. Care shall be taken so that the blasting cap is not pulled out. Care shall be taken so that the electric blasting cap, leading wire or the length of the fuse does not get damaged during loading of the charge.
 - j. No attempt shall be made to slit, drop, deform or abuse the primer.
 - k. Blasting caps or electric blasting caps shall not be connected to detonating fuse except by methods recommended by the manufacturers of caps.
 - l. Explosive cartridge shall not be cut, nor explosive removed from the cartridge for use.
 - m. Metallic devices of any kind shall not be used in tamping. Wooden tamping tools with not exposed metal parts except non-sparking metal connectors for jointed poled shall be used. Violent tamping shall be avoided. Primer shall not be tamped.
 - n. Care shall be taken to confine the explosives in the bore hold with sand, earth clay or other suitable combustible stemming material.
 - o. Kinking or injuring of fuse or electric blasting cap wires shall be avoided when tamping.

10.5. ELECTRICAL SHOT-FIRING CIRCUIT

- a. In deciding the sizes of wires, fuses, circuits, blasting switches, etc., instructions issued by the manufacturers of these articles shall be followed, if they do not contradict with Indian Explosives Act or framed under it.
- b. No person shall attempt to uncoil the wires and open out the short-circuited bare leading wires of the electric blasting cap during approach of dust storm or near any source of large

charge of static electricity or near a radio transmitter. The manufacturer of the cap or the Inspectorate of Explosives shall be consulted regarding the distance from the transmitter beyond which electric short firing shall be conducted.

- c. Firing circuit shall be kept completely insulated from the ground of the other conductors, such as wires, rails, pipes or other paths or stray current.
- d. There shall not be any electric live wires or cables of any kind near electric blasting caps or other explosives except at the time and for the purpose of firing the blast.
- e. All electric blasting caps shall be tested singly and also when connected in a circuit in series using only an approved type of circuit continuity tester or ohmmeter.
- f. No attempt shall be made to use in the same circuit either electrical blasting caps made by more than one manufacturer or electric blasting caps of different design or function even if made by the same manufacturers unless such use is approved by the manufacturers.
- g. No attempt shall be made to fire a circuit of electric blasting caps with less than the minimum current specified by the manufacturer of that electric blasting cap.
- h. Care shall be taken to ensure that all wire ends to be connected are bright and clean.
- i. The electric cap wires or leading wires shall be kept short circuited until ready to fire.
- j. When energy for blasting is taken from power circuits the voltage shall not exceed 220v. The wiring controlling arrangements shall conform to the following:
- k. The blasting switch shall be strictly according to the specifications, externally operated double-throw switch, which when locked in the open position will short circuit and ground the leading wires. The switch shall be installed at the location where the firing is to be controlled.
- l. A 'safety' switch of the same type as the blasting switch shall be installed between the blasting switch and the firing circuit and lead lines, at a distance not to exceed 180cm from the blasting switch.
- m. Both the safety switch and the blasting switch shall be locked in the open position immediately after the shot and before any person is permitted to return to the blasting area. Key to the switches shall remain in the possession of the blaster at all times.
- n. Rubber covered or other adequately insulated copper wires in good condition shall be used for firing lines and shall have solid cores of appropriate gauge. Sufficient firing line shall be provided to permit the blaster to be located at a safe distance from the blast. Single conductor lead lines shall be used.
- o. Blasting operations in the proximity of overhead power lines, communication lines, utility lines, or other structures shall not be carried on until the operator or the owner, or both of such lines as been notified and precautionary measures deemed necessary, have been taken.
- p. All holes loaded on a shift shall be fired on the same shift.
- q. As far as possible, blasting shall be carried out using suitable exploder with 25 per cent excess capacity. Electric power from the mains shall be used only when it is absolutely necessary.

10.6. SHOT-FIRING WITH SAFETY FUSE

- a. The fuse shall be carefully handled to avoid damaging the covering. In very cold weather the fuse shall be slightly warmed before using so as to avoid cracking the waterproofing.
- b. Short fuse shall not be used. The length of a fuse shall not be less than 120cm. The rate of burning of the fuse shall be known and it would be necessary to make sure that it will take sufficient time in burning so as to enable all persons to reach a place of safety. The burning rate of the fuse shall not be more than 60 cm/min.
- c. The fuse shall not be cut until the operation to insert the fuse into a blasting cap is ready. The fuse shall be cut off about 2.5 to 5 cm to ensure a dry end. It shall be cut squarely across with a clean and sharp blade. The fuse shall be seated lightly against the cap charge and care shall be taken to avoid twisting after it has been placed in position.
- d. Blasting caps shall not be crimped by any means except by a cap crimper designed for the purpose. It shall be necessary to make sure that the cap is squarely crimped to the face.
- e. The fuse shall be lighted with a fuse lighter designed for the purpose. If a match is used, the fuse shall be slit at the end and the match head held in then slit against the power core and then the match head rubbed against an abrasive surface to light the fuse.
- f. The fuse shall not be lighted until sufficient stemming has been placed over the explosives to prevent sparks of live match heads from coming into contact with the explosives.
- g. The explosives shall not be held in hands when lighting the fuse.

10.7. UNDERGROUND WORK

- a. Only permissible explosives and in the manner as specified by the appropriate authority shall be used.
- b. Excessive quantities of explosives shall not be taken underground at any time. Black blasting powder or pellet powder shall not be used with any other explosive in the same borehole.

10.8. BEFORE AND AFTER FIRING

- a. Before firing, sufficient warning shall be given to enable the people working in the area to get off the danger zone. The danger zone shall be suitable cordoned off and flag men posted at important points.
- b. No loose materials, such as tools, drilling implements etc. Shall be left on the rock surfaces to be blasted.
- c. Blasting in the open shall be carried out during the fixed hours every day or on fixed days in the week. This information shall be amply publicized and the following precautions observed:
- d. On the project sites, where blasting operations are carried out, daily blasting hours shall be clearly printed on the sign-boards on all the roads approaching that area.
 - i. Road closing barriers should be provided to close the traffic on these roads, at least 400 meters away when the firing is to take place.

- ii. The beginning of the firing shall follow loud sirens and similarly loud sirens shall succeed the completion of the firing.
- e. The shot-firer shall not be allowed to return to the blasting site after firing, until at least 5 min have elapsed. In case of electric shot firing, the shot holes shall be examined after firing and in case of misfire no person shall be allowed to approach the blasting site for at least 5 min. In case of shot firing with safety fuse, utmost care shall be taken to count the number to ensure that all the shots have fired and in the event of misfire, no person shall be allowed to approach the blasting site for at least 30 min. In any case, a careful inspection for the remaining un-detonated explosive shall be made after firing the shots. All misfired shot holes shall be cross-marked. No other person than those duly authorized shall approach the holes until one of the following operations has been performed in respect of each of the misfired holes:
 - f. If the misfire is due to a faulty cable or faulty electrical connection the defect shall be remedied and the shot fired.
 - g. The stemming shall be floated out by use of water or air jet from hose until the hole has been opened to within 60 cm of the charge, whereupon water will be siphoned or pumped out, then a fresh new charge placed and duly detonated. Or
 - i. A careful search shall be made of unexploded material in the debris of the charge.
 - ii. If a shift charge is unavoidable, the person in-charge of one shift before leaving the work shall inform the person relieving him for the next shift of any cases misfired and shall point out their position duly cross marked and also state clearly what action has to be taken in the matter.

Note: The rules are made considering statutory provisions and other National/International standards. However, if any statutory provision overruling these laws is made, the statutory provisions shall overrule the NTPC Rules.

11.0 SAFETY IN EXCAVATION & TUNNELING WORK

SAFETY IN EXCAVATION

11.1 GENERAL PROVISIONS

- a. Before undertaking any activity, the soil shall be tested and in case of availability of any explosive gas, necessary arrangements must be made to remove/dilute such gases and in case they are found to be toxic or poisonous, the workplace must be purged and continuous ventilation maintaining the contamination below the permissible level ensured;
- b. The position of underground installations such as sewers, water pipes and electrical cables shall be verified and in case of their existence, they must be isolated;
- c. If they cannot be isolated or removed or shutdown, they shall be fenced, hung up or otherwise protected. On every part likely to be visited by persons or where transport vehicles ply, the area shall be suitably fenced, guarded or barricaded to prevent fall of persons, vehicles or livestock into the excavated area;
- d. Warning signs shall be erected and the in the night hours the area shall be illuminated to warn pedestrians and vehicular traffic;
- e. Arrangements shall be made to prevent external vibrations due to rail/road traffic;
- f. Blasting shall be carried out in accordance with the norms applicable in this regard. Special care shall be taken to control the impact of vibrations/tremor caused by blasting to protect excavations from cave-ins;
- g. Arrangements shall be made to save other buildings/structures in the affected zone or in the vicinity of the area of excavation, from collapse;

11.2 SHORING AND TIMBERING

- a. Site of excavations, where workers are exposed to danger from moving ground, shall be made safe by maintaining due slope not exceeding the angle of repose of different types of soil or otherwise by shoring, portable shields or other effective means;
- b. All trenches in the soil, other than rock or hard compact soil more than 1.5 m deep into which men enter, shall be securely shored and timbered under the supervision of a competent person and only the trained workers shall be allowed to substantially alter or dismantle the shoring or timbering;
- c. All struts, braces and walls in excavation shall be adequately secured so as to prevent their accidental displacement;
- d. In all excavations in soft or fissured rock or hard soil exceeding 2 m in depth, except those which are sloped to within 1.5 m of the bottom into which men enter, shall be securely shored and timbered;
- e. Where the sides of the excavations are sloped as outlined above, but not within the 1.5 m of the bottom, vertical sides shall be shored and the shoring shall extend at least 30 cm above the vertical sides. When open spaced sheathing is used, a toe-board shall be provided to prevent material rolling down the slope and falling into the excavated.

11.3. SHEATHING

- a. The sheathing should be placed against the side of the trench so that length of each piece of sheathing is vertical. It should be held securely in place against the wales by ensuring that sheathing is kept firmly pressed against the wall of the trench. Where the trench excavated is loose, sandy or soft soil or soil which has been previously excavated or soil which is under hydrostatic pressure, each piece of sheathing shall be driven into the bottom of the trench so as to firmly hold it in place;
- b. Where two or more pieces of sheathing are used one above another, the sheathing shall be so arranged that the lower pieces of sheathing shall overlap the lowest wales supporting the piece of sheathing next above it. These pieces of sheathing shall be firmly driven into the soil and securely supported by wales and struts, as the trench is made deeper.

11.4. WALES

- a. The wales shall be parallel to the bottom or the proposed bottom of the trench. Each wale shall be supported on cleats spiked to the sheathing or by posts set on the wales next below it and in the case of the lowest wale on the bottom of the trench itself. Where necessary, wedges may be provided between a wale and the sheathing it supports so that roughly uniformity is given to all individual pieces of sheathing.

11.5. STRUTS

- a. Struts shall be horizontal and at right angles to the wales or sheathing supported thereby. Struts shall be cut to the proper length required to fit in tightly between the wales. Where necessary, the struts shall be held securely in place by wedges, driven between the struts and the wales;
- b. Struts shall be placed on cleats spiked or bolted to the posts supporting the Wales.

11.6. LOOSE SITE MATERIALS:

No loose material shall be kept very close to the excavation creating possibility of its fall into the excavated area. A safe distance of at least 1 m shall be maintained.

11.7. PLANT & MACHINERY:

Movement of vehicles and heavy equipment shall be kept at a distance least equal to the depth of the excavation or at least 6 m for excavation deeper than 6 m and the workers shall be provided with proper tools.

11.8. MEANS OF ACCESS

- a. For trenches deeper than 1.5 m, safe means of access and egress shall be provided at intervals of every 15 m. Where it is not possible to provide safe means of access and egress as above, ladders shall extend from the bottom of the trench to at least 90 cm above the ground;
- b. Walkways, runways and sidewalks shall be kept clear of excavated materials or other obstructions and no side walls shall be undermined-undercut unless it is capable of carrying a minimum live load of 125 lbs per square feet;

- c. If planks are used for raising walkways, runways or sidewalks, they should be parallel to the length of the walk and fastened together against displacement;
- d. Lone worker shall not be allowed to work in the excavated area.

11.9. INSPECTIONS:

A competent person shall make inspections every day and necessary measures shall be taken to safeguard against possible cave-ins or slide or collapse of the excavations.

11.10. NOTIFICATION OF INTENTION TO CARRY OUT EXCAVATION AND TUNNELING WORK

- a. Within thirty days, prior to the commencement of such excavation or tunneling work, the contractor shall inform in writing the detailed layout plans, method of construction and schedule of such excavation or tunneling work to the Engineer in-charge of NTPC;
- b. In case compressed air is used in such excavation or tunneling work or any work incidental to or required for such excavation or tunneling work, the technical details and drawings of all man-locks and medical-locks together with names and addresses of all construction medical officers duly qualified and so appointed by such contractor for the purpose of such excavation or tunneling work shall be sent to the Engineer in-charge.

11.11. PROJECT ENGINEER

- a. The contractor undertaking any excavation or tunneling work shall appoint a Project Engineer for safe operation of such projects;
- b. Such Project Engineer shall exercise overall control of the operations and the activities at such project and be responsible for carrying out the activities safely.

11.12. RESPONSIBLE PERSON

- a. The contractor undertaking excavation or tunneling work at construction site of a building or other construction work shall appoint a responsible person for safe operation of such excavation or tunneling work;
- b. The name and addresses of such responsible persons shall be forwarded to the Engineer in-charge;
- c. Duties and responsibilities of the responsible person referred to above person shall include
 - i. To carry out smoothly such excavation or tunneling work;
 - ii. To inspect and rectify any hazardous situation relating to such excavation or tunneling work;
 - iii. To take remedial measures to avoid any unsafe practice or conditions relating to such excavation or tunneling work.

11.13. WARNING SIGNS AND NOTICES

- a. Suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunneling, shall be displayed or erected at conspicuous places in Hindi

and in language understood by the majority of such building workers at such excavation or tunneling work;

- b. Such warning signs and notices with regard to compressed air working shall include:
 - i) The danger involved in such compressed air work;
 - ii) Fire and explosion hazards;
 - iii) The emergency procedures for rescue from such danger or hazards.

11.14. REGISTER OF EMPLOYMENT

- a. The contractor shall ensure that at a construction site of a building or other construction work where an excavation or tunneling work is being carried on, a register of employment of building workers carrying out such excavation or tunneling work is maintained and produced on demand;
- b. Periods of work of such excavation or tunneling work shall be maintained in a register on day-to-day basis and such register shall be produced on demand

11.15. ILLUMINATION

- a. All contractors carrying out excavation or tunneling work at a construction site of a building or other construction work shall provide for emergency generators on such construction site to ensure adequate illumination at all work places where such excavation or tunneling work is being carried out;
- b. In case of power failure, all workplaces where excavation or tunneling works are carried out shall be adequately illuminated

11.16. PNEUMATIC TOOLS:

Supply lines to pneumatic tools used within a tunnel are fitted with water trap or safety chain or safety wire, as the case may be.

11.17. STABILITY OF STRUCTURE DURING GENERAL EXCAVATION & TUNNELING:

The contractor shall ensure that where there is any doubt as to the stability of any structure adjoining the workplace or other areas to be excavated or where tunneling work is to be carried out –

- a. The Project Engineer shall arrange for measures like underpinning, sheet piling, shoring, bracing or other similar means to support such structure and to prevent injury to any building worker working adjacent to such structure or damage to property or equipment adjacent to such structure;
- b. Where any building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 m above his footing, such worker shall be protected by adequate piling and bracing against such bank or side;

- c. The excavation and its vicinity shall be checked by a responsible person after every rain, storm or other occurrences carrying hazards and in case a hazard is noticed at such checking, adequate protection against slides and cave-in to prevent such hazard shall be provided;
- d. Temporary sheet piling installed for the construction of a retaining wall after excavation shall not be removed, except on the advice of the responsible person after an inspection carried out by such responsible person;
- e. Where banks of an excavation are undercut, adequate shoring shall be provided to support the material or article overhanging such bank;
- f. Excavated material shall not be stored at least 0.5 m from the edge of an open excavation or trench and the banks of such excavation or trench shall be stripped of loose rocks and other materials which may slide, roll or fall upon a building worker working below such bank;
- g. Adequate and suitable warning signs shall be put-up at conspicuous places at the excavation work to avoid any person falling into the excavations or trenches;
- h. The responsible person shall ensure at the excavation that no building worker is permitted to work where such building worker may be struck or endangered by the excavation machinery or material or article used in such excavation.

11.18. SAFE ACCESS AND EGRESS:

Ladders, staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where the depth of such excavation exceeds one point 1.5 m and such ladders, staircases or ramps comply with the relevant national standards.

11.19. TRENCHES

- a. A trench or excavation shall be protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection shall be an improved protection in accordance with the design and drawing of a Professional Engineer, where such depth exceeds 4 m;
- b. Where the depth of a trench requires two lengths of sheet piling, one above the other, the lower piling shall be set inside the bottom strings or wales of the upper piling and such sheet piling shall be driven down and braced as the excavation continues;
- c. All metal sheet piles used in excavation or a trench shall be welded end-to-end and secured by other similar means.

11.20. POSITIONING AND USE OF MACHINERY:

Any machinery used in excavation and tunneling work shall be positioned and operated in such a way that such machinery will not endanger the operator of such machinery or any other person in the vicinity.

11.21. BREATHING APPARATUS:

Suitable breathing apparatus shall be provided to a building worker while working in compressed air environment for his use at excavation or tunneling work and such breathing apparatus shall be maintained in good working condition at all times.

11.22. SAFETY MEASURES FOR TUNNELING OPERATIONS

- a. Where there is a danger of falling or sliding of material from the roof face or wall of a tunnel, adequate measures such as shoring, supporting by means of rock bolts, segments or steel sets shall be taken for the safety of building workers;
- b. The excavated areas shall be made safe by use of suitably designed and installed steel sets, rock bolts or similar other safe means;
- c. The responsible person shall examine and inspect the workplaces in a tunnel before the commencement of work in such tunnel and at regular intervals thereafter to ensure safety of the building workers in such tunnel;
- d. The portal areas of a tunnel with loose soil or rock, likely to cause injury to a person shall be adequately protected with supports.

11.23. SURROUNDINGS OF A SHAFT

- a. Surroundings of a shaft used in excavation or tunnel work shall be protected from being washed away by construction of sufficient height;
- b. Where a building worker is required to enter a shaft at an excavation or tunneling work, safe means of access shall be provided for such entry;
- c. Every shaft at excavation or tunneling work shall be provided with a steel casing, concrete piping, timber shoring or other materials of adequate strength for the safety of building workers working in such shaft;
- d. Such casing and bracing shall be provided to shafts at an excavation or tunneling work according to the appropriate design for such casing and bracing;
- e. A reinforced concrete raft and beam shall be provided around the opening of a shaft at an excavation or tunneling work if the ground surrounding such opening is unstable or unsafe.

11.24. LIFT FOR SHAFT:

Lift shall be provided for transport of building workers and materials or articles at an excavation or tunneling work required to descend more than 50 m in a shaft.

11.25. MEANS OF COMMUNICATION

Reliable and effective means of communication such as telephone or walkie-talkie shall be provided and maintained in working order for arranging better and effective communication at an excavation or tunneling work at the following locations, namely:

- i. Working chamber of an excavation;
- ii. Intervals of hundred meters along the tunnel;
- iii. Working chamber side of a man lock near the door of such man lock;
- iv. Interior or each chamber of a man lock;
- v. Location conspicuous lock attendant's situation;
- vi. A compressor plant;

- vii. A first-aid station, and
- viii. Outside the portal or the top of a shaft;
- ix. Such number of bells and whistles shall be made available at all times at the locations as are necessary for the safety of persons at such locations.

11.26. SIGNALS:

The standard audio or video signals shall be used in excavation or tunneling work and conspicuously located or displayed near entrance to the workplace and in such other locations as may be necessary to bring such signals to notice of all building workers employed in such excavation or tunneling work.

11.27. CLEARANCES

- a. The minimum lateral clearances of 0.5 m shall be maintained between any part of a vehicle and any fixture or any equipment used in an excavation or tunneling work after allowing the throw or swing of such fixture or equipment;
- b. The overhead clearance for a locomotive drive at excavation or tunneling work shall not be less than 1.20 m above the seat of such driver and not less than 2 m above the platform where such driver stands or of any other dimension in accordance with the approved standard.

11.28. SHELTERS:

The adequate number of shelters for the safeguard of the building workers are provided where, in the course of working, they are liable to be struck by a moving vehicle or other material handling equipment in a tunnel.

11.29. USE OF INTERNAL COMBUSTION ENGINE:

No internal combustion engine shall be used underground in excavation or tunneling work unless such engine is so constructed that the air entering the engine gets cleared before entry and the engine emits no fumes or sparks.

11.30. INFLAMMABLE OILS:

Inflammable oils with the flash point below the working temperature that is likely to be encountered in a tunnel shall not be used in excavation or tunneling work.

11.31. COUPLING AND HOSES:

All high-pressure hydraulic hoses and couplings shall be adequately protected against any possible damage in excavation or tunneling work.

11.32. HOSE INSTALLATION:

All hydraulic lines and plants working at a temperature exceeding 750 c shall be protected by adequate insulation or otherwise against accidental human contact in excavation or tunneling work.

11.33. FIRE RESISTANT HOSES:

No fire hydraulic hoses other than fire resistant hydraulic hoses are used when hydraulically activated machinery and equipment are employed in tunnels.

11.34. FLAMEPROOF EQUIPMENT:

Only flameproof equipment of appropriate type as per approved standards shall be used where there is a danger of flammable or explosive atmosphere being prevalent inside the tunnel.

11.35. STORING OF OIL AND FUEL UNDERGROUND:

All oils, greases or fuels stored underground in excavation or tunneling work shall be kept in tightly sealed containers and in fire resistant areas at safe distances away from explosive and other flammable chemical and appropriate flameproof installation shall be used in such storage areas.

11.36. USE OF GASES UNDERGROUND

- a. Petrol or liquefied petroleum gas or any other flammable substances shall not be used or stored inside the tunnel except with the prior approval of the Project Engineer;
- b. After the use of the petroleum or liquefied petroleum gas, or highly inflammable substances, all remaining petroleum or liquefied petroleum gas or highly inflammable substances shall be removed immediately from such tunnel;
- c. No oxy-acetylene gas shall be used in a compressed air environment in excavation or tunneling work.

11.37. WATER FOR FIRE FIGHTING

- a. Adequate number of water outlets shall be provided on excavation or tunneling work and readily made accessible throughout the tunnel for fire fighting purposes and such water outlets shall be maintained for effective fire fighting;
- b. All air locks shall be equipped with fire fighting facilities at excavation or tunneling work;
- c. An audible fire alarm shall be provided to warn the building workers whenever a fire breaks out on an excavation or tunneling work;
- d. Adequate number and types of fire extinguishers, in accordance with relevant national standards, shall be provided and made readily available to fight any outbreak of fire at an excavation or tunneling work;
- e. Fire extinguishers with vaporizing liquids and high pressure carbon dioxide shall not be used in tunnels or other confined spaces;
- f. The instructions regarding steps to be followed to fight outbreak of fire, at an excavation or tunneling work, written in Hindi or local language understood by the majority of the building workers employed on such excavation or tunneling work, shall be displayed at conspicuous and vulnerable places of such excavation or tunneling work.

11.38. FLOODING

- a. Water tight bulkhead doors shall be installed at the entrance of a tunnel to prevent flooding during a tunneling work where more than one tunnel is driven from a shaft;
- b. All necessary measures shall be taken to ensure that no building worker is trapped in any isolated section of a tunnel when any bulkhead door of such tunnel is closed;
- c. Where there is likelihood of flooding or water rushing into a tunnel during a tunneling work, arrangements shall be made for immediate starting of water pumps to take out water of such flooding or water rushing and for giving alert signals to the building workers and other persons to keep them away from danger.
- d. Airtight steel curtains shall be provided in areas liable to flooding at tunneling work and in case of descending tunnels, such curtains shall be provided in the top half of such tunnels to ensure the retention of pockets of air for rescue purpose.

11.39. REST SHELTERS

- a. Where building workers employed in a compressed air environment in a tunneling work are required to remain at the work site for one hour or more after de-compression from pressure exceeding one bar, adequate and suitable facilities shall be provided for such building workers to rest;
 - a. Every man-lock, medical-lock and any other facility inside these locks in a tunneling work shall be maintained in a clean state and in good repairs;
 - b. A first-aid room shall be provided and readily available at a construction site of a tunneling work;
 - c. Each man-lock attendant at the station shall be provided with a first-aid box.

11.40. PERMISSIBLE LIMIT OF EXPOSURE OF CHEMICALS

- a. The working environment in a tunnel or a shaft in which building workers are employed shall not contain any of the hazardous substances in concentrations beyond the permissible limits;
- b. The responsible person referred to shall conduct necessary test before the commencement of a tunneling work for the day and at suitable intervals as fixed by the Engineer in-charge, to ensure that the permissible limits of exposure are not exceeded and a record of such test shall be maintained and made available for inspection.

11.41. VENTILATION:

All working areas in a free air tunnel shall be provided with the approved ventilation system and the fresh air supplied in such tunnel shall not be less than 6 m³ per minute for each building worker employed underground in such tunnel and the free air-flow movement inside such tunnel not less than 9 m³ per minute.

11.42. AIR SUPPLY INTAKE POINT:

The air intake points for all air compression shall be located at places where such intake air does not get contaminated with dust, fumes, vapor and exhaust gases or other contaminants.

11.43. EMERGENCY GENERATORS

- a. Every compressed air system in a tunnel shall be provided with emergency power supply system for maintaining continued supply of compressed air in such compressed air system, which shall be capable of operating air compressor and ancillary systems of such compressed air system;
- b. The emergency power supply system shall be maintained and made readily available at all times.

11.45. AIR MAINS:

Every air-main supplying air to the working chamber, man-lock or medical-lock used at an excavation or tunneling work shall be protected against accidental damage and where it is not practicable to provide such protection, a stand-by air-main shall be provided.

11.46. BULKHEAD AND AIR LOCKS

- a. A bulk head or air tight diaphragms retaining compressed air, when used within a tunnel or a shaft, shall be constructed to withstand the maximum pressure at 1.25 the maximum working pressure of such bulk head or diaphragm and such bulk head or diaphragm shall be tested before its each use by a responsible person to ensure that such bulk head or diaphragm is in proper working order;
- b. Such responsible person shall keep the record of each test and such record shall be produced for inspection.
- c. The bulk head or diaphragm shall be made of sound material of adequate strength, which shall be able to withstand the maximum pressure on which they are subjected to at any time of their use;
- d. A bulkhead anchorage and air lock shall be tested at its work place at an excavation or tunneling work immediately after their installation at such place.

11.47. DIAPHRAGM:

All diaphragms, which are in the form of horizontal decks across a shaft used at excavation or tunneling work, shall be securely anchored

11.48. PORTABLE ELECTRICAL HAND TOOLS:

All portable electrical hand tools and inspection lamps used underground or in a confined space shall be operated at a voltage not exceeding 24 V.

11.49. CIRCUIT BREAKER

- a. Adequate numbers of differential ground fault circuit breakers shall be installed for every electrical distribution system and its sub-systems used at an excavation or tunneling;
- b. Work and the sensitivity of each of circuit breaker shall be adjusted in accordance with the requirement set out in accordance with the approved standards;
- c. No semi-enclosed fuse unit shall be used in underground place.

11.50. TRANSFORMER:

The contractor shall ensure no transformer is used in any section of a tunnel under compressed air unless such transformer is of the dry type and conforms to the approved standards.

11.51. LIVE WIRES:

There shall be no exposed live wire in working areas at an excavation or tunneling work which are accessible to building workers other than those authorized to work on such live lines.

11.52. WELDING SETS:

All welding sets used in a tunnel shall be of adequate capacity and of suitable type, duly approved.

11.53. QUALITY AND QUANTITY

- a. Every working chamber at an excavation or tunneling work where compressed air is used, the supply of such air shall be maintained at not less than 0.3 m³ per minute per person working therein;
- b. A reserve supply of compressed air shall be made available at all times for man-locks and medical locks used at a tunneling work;
- c. The air supplied in a compressed air environment at a tunneling work shall be, as far as practicable, free from contaminants, namely, dust, fumes and other toxic substances.

11.54. WORKING TEMPERATURE:

The temperature in any working chamber at an excavation or tunneling work where building workers are employed shall not exceed 29° c and the arrangement shall be maintained for keeping records in which the temperatures measured by dry bulb and wet bulb inside such working chamber once in every hour and for producing such records for inspection on demand.

11.55. MAN-LOCKS AND WORKING IN COMPRESSED AIR ENVIRONMENT

- a. Man-locks used at a tunneling work shall be of adequate strength, made of sound material and designed to withstand any pressure, internal or external, to which it may be subjected in the normal use or in an emergency;
- b. Doors of man-locks at an excavation or tunneling work shall be made of steel and used at a tunneling work for keeping the work airtight and devices shall be provided for sealing the doors when such locks are under pressure. The anchorage of a man-lock used at tunneling work shall have adequate strength to withstand the pressure exerted by air on the man-lock. There shall be adequate room available for the workers for working in the man-locks;
- c. Where work is carried out in any compressed air tunnel, a Man-lock in accordance with the approved standards shall be used;
- d. Where a man-lock is used, safety Instructions in Hindi and in local language understood by majority of building workers employed there, shall be displayed at conspicuous places;
- e. Except in an emergency, compression and de-compression operations shall be carried out in a man-lock and in an emergency any material-lock may be used;
- f. A record of compression and de-compression shall be kept in writing and produced for inspection on demand;
- g. Material lock shall be used with the permission of the Engineer in-charge where it is impracticable to install both the man-lock and the material-lock at;
- h. The man-lock at tunneling work shall not be used for any purpose

- i. other than compression or de-compression of building workers;
- j. No de-canting of building workers at tunneling work shall be carried
- k. out without prior approval of the Engineer in-charge except in an emergency;
- l. In case a building worker collapses or is taken ill during his de-compression in a man-lock, the lock attendant of such man-lock shall raise the pressure to a level equal to the maximum pressure which that building worker was exposed to in the working chamber prior to such de-compression and such lock attendant shall immediately report the matter relating to such collapse to the medical lock attendant and medical officer on duty;
- m. A building worker who had previously received training with a trained building worker to work in a compressed air environment at tunneling work shall be employed to work independently in such a compressed air environment;
- n. A building worker who had undergone three de-compressions from a pressure exceeding one bar in a period of eight hours at tunneling work shall not be allowed to enter a compressed air environment except for the purpose of carrying out rescue work;
- o. A building worker employed in a compressed air environment for a period of eight hours in a day at tunneling work shall not be employed again in such environment unless he has spent not less than twelve consecutive hours of rest at atmospheric pressure;
- p. No building worker shall be engaged in a compressed air environment at a pressure, which exceeds three bars at a tunneling work unless prior permission, in writing, has been obtained from the Engineer in-charge;
- q. No building worker shall be employed in a compressed air environment for more than fourteen consecutive days in a month;
- r. A register of employment of all building workers in compressed air environment shall be maintained;
- s. An identification badge shall be supplied to a building worker employed in compressed air environment;
- t. The badge of a building worker shall contain particulars of his name, location of the medical-lock allotted to him for work, the telephone number of the Construction Medical Officer concerned for his treatment and the instructions in case of his illness of unknown and doubtful causes;
- u. Record of all identification badges supplied to building shall be kept in a register;
- v. Every building worker whose name appears in the register shall wear the badge supplied to him at all times during his duty hours;
- w. Suitable warning signs shall be displayed in the compressed air for the prohibition of the following, namely:
 - i) Use of alcoholic drinks;
 - ii) Use and carrying of lighters, matches or other sources of ignition;
 - iii) Smoking; and

iv) No entry to person who has consumed alcoholic drink

11.56.SAFETY INSTRUCTION:

All building workers employed in compressed air environment at tunneling work shall follow the instructions issued for their safety in the course of such employment.

11.57.MEDICAL-LOCK

- a. A suitably constructed medical lock shall be maintained at tunneling work where building workers are employed in a working chamber at a pressure exceeding one bar;
- b. Where more than one hundred building workers are employed in a compressed air working environment exceeding one bar at tunneling work, one medical-lock is provided for every one hundred building workers or part thereof and such medical lock shall be situated as near as possible to the main-lock used at such tunneling work.

12.0. SAFETY IN PILING WORK

12.1. GENERAL PROVISIONS

- a. All pile driving equipment shall be of good design and sound construction, taking into account the ergonomic principles and properly maintained;
- b. A pile driver shall be firmly supported on a heavy timber sill, concrete bed or other secured foundation;
- c. In case a pile driver is required to be erected in dangerous proximity to an electrical conductor, all necessary precautions shall be taken to ensure safety;
- d. The hoses of steam and air hammer shall be securely lashed to such hammer so as to prevent them from whipping in case of connection or break;
- e. Adequate precaution shall be taken to prevent the pile driver from over turning and hammer from missing the pile;
- f. A responsible person for inspecting pile-driving equipment shall inspect such equipment before taking it into use and takes all appropriate measures as required for the safety of building workers before commencing piling work by such equipment;
- g. Where there is any question of stability of a structure for its adjoining areas to be piled, such structure shall be supported, where necessary, by underpinning, sheet piling, shoring, and bracing or by other means to ensure safety and stability of such structure and to prevent injury to any person.

12.2. PROTECTION OF OPERATOR:

The operator of every pile driving equipment shall be protected from falling objects, steam, cinders or water by substantially covering or otherwise or by other means.

12.3. INSTRUCTION TO AND SUPERVISION OF BUILDING WORKERS WORKING ON PILE-DRIVING EQUIPMENT:

Every building worker working on a pile driving equipment shall be given instructions regarding safe work procedure to be followed in piling operation and shall be supervised by a responsible person throughout such work.

12.4. ENTRY OF UNAUTHORIZED PERSON:

The contractor shall ensure at a construction site of a buildings or other construction work that all piling areas where pile-driving equipment is in use are effectively cordoned off to prevent entry of unauthorized persons.

12.5. INSPECTION AND MAINTENANCE OF PILE DRIVING EQUIPMENT

- a. Pile-driving equipment shall not be taken into use until it has been inspected by a responsible person and found to be safe for such use;
- b. A responsible person for such inspection at suitable intervals to ensure safety to the building worker working on such equipment shall inspect pile driving equipment in use;

- c. All pile lines and pulley blocks shall be inspected by a responsible person before the beginning of each shift of piling operations.

12.6. OPERATION OF PILE-DRIVING EQUIPMENT

- a. Only experienced and trained building worker shall operate pile driving so as to avoid any probable danger from such operation;
- b. Pile-driving operations shall be governed generally prevalent and accepted signals so as to prevent any probable danger from such operations;
- c. Every building worker employed in pile driving operation or in the vicinity of such pile driving operation shall wear ear protection and safety helmet or hardhat and safety shoes;
- d. Piles shall be prepared at a distance, at least equal to twice the length of the longest pile, from the place of pile-driving operations;
- e. When a pile driver is not in use, the hammer of such pile driver shall be blocked at the bottom of the heads of such pile driver.

12.7. WORKING PLATFORM ON PILING FRAMES:

Where a structural tower supports the lead of a pile driver, leads at which it is necessary for the building workers to work and such platforms except on the hammer of such pile driver or lead sides of such platform and where such platforms cannot be provided with such railing and toe boards, a safety belt shall be provided to each such building worker.

12.8. PILE TESTING

- a. The testing of pile shall be conducted under the supervision of a responsible person for such testing;
- b. All practicable measures like displaying of warning notices, barricading the area and other similar measures shall be taken to protect the area where the pile testing is carried out;
- c. Entry to a pile testing area shall be prohibited to general public to ensure safety.

12.9. PILING, SHORING AND BRACING

- a. Planks used for sheet piling in excavation or tunneling work shall be of sound material with adequate strength;
- b. Shores and braces used in excavation or tunneling work shall be of adequate dimensions and so placed as to be effective for their intended purposes;
- c. Earth supported shores or braces used in excavation or tunneling work shall bear against a footing of sufficient area and stability to prevent the shifting of such shores or braces.

13.0. SAFETY IN THE ERECTION, USE AND DISMANTLING OF SCAFFOLDS

13.1. SCAFFOLD CONSTRUCTION

- a. Every scaffold and every component thereof shall be of adequate construction, made of sound material and free from defects and safe for the purposes for which it is intended for use;
- b. In case bamboo is used for scaffolding, such bamboo shall be of suitable quality, good condition, free from protruding knots and stripped off to avoid any injury to building workers during handling such bamboo;
- c. All metal scaffolds used in building or other construction work shall conform to the approved standards;

13.2. SUPERVISION BY A RESPONSIBLE PERSON: No scaffold shall be erected, added, altered or dismantled except under the supervision of a responsible person.

13.3. Maintenance

- a. The scaffold used in building or other construction work shall be maintained in good repairs and the measures taken against its accidental displacement or any other hazard;
- b. No scaffold or part thereof shall be partly dismantled and allowed to remain in such a condition unless –
 - i) The stability or safety of the remaining portion of such scaffold has been ensured by a responsible person for the safety of such scaffolds;
 - ii) In case the remaining part of such scaffold cannot be used by the building workers, necessary warning notice written in Hindi and in a language understood by the majority of the building workers that such scaffold is unfit for use, shall be displayed at the place where such scaffold is erected.

13.4. STANDARDS, LEDGERS, PUTLOGS

- a. Standards of a scaffold shall be plumb, where practicable, fixed sufficiently close together to secure the stability of such scaffold having regard to all the possible working situations and conditions for the intended use of such scaffold, spaced, as close as practicable, to ensure safety and stability of such scaffold;
- b. Adequate measures are taken to, prevent displacement of a standard of a scaffold either by providing sole plate or a base plate, as necessary;
- c. Ledgers of metal scaffold are placed at vertical intervals with due regard to safety and stability of such scaffold;
- d. Bamboo ledgers are kept as nearly as possible and are placed and fastened to the standards of a scaffold with due regard to the stability of such scaffold.

13.5. WORKING PLATFORM

- a. Working platform shall be provided around the face or edge of a building adjoining at every upper most permanent floor of such building under construction and at any level where construction work of such building is carried out;
- b. A platform shall be designed to suit the number of building workers to be employed on each bay of a scaffold work on such platform and the materials or articles and tools to be carried with them in such bay;
- c. The safe working load and the number of building workers to be employed in each bay of a scaffold shall be displayed for the information of all the building workers employed at such construction site.

13.6. BOARD, PLANK AND DECKING

- a. Board, plank and decking used in the construction of a working platform shall be of uniform size and strength and shall be capable of supporting the load and number of building workers keeping in view the safety of such building workers;
- b. Metal decking, which forms part of a working platform, shall be provided with non-skid surface;
- c. No board or plank which forms the working platform shall be projected beyond its end support unless it is effectively prevented from tripping or lifting and board, plank or decking shall be fastened and secured;
- d. At any one time, not more than two working platforms per bay, shall be used to support building workers or materials or articles at such bay;
- e. Adequate measures shall be taken to prevent injury which may be caused by falling material and objects by using safety nets or other suitable means;
- f. Concrete, other debris or materials shall not be allowed to accumulate at any platform on a scaffold;
- g. Where a work is to be done at the end of a wall, working platform at such workplace shall be faced or, wherever practicable, at least 0.6 m beyond the end of such wall.

13.7. REPAIR OF DAMAGED SCAFFOLD

- a. No building worker shall be permitted to work on a scaffold that has been damaged or weakened unless adequate safety measures have been taken to ensure the safety of such building worker;
- b. Necessary warning signs shall be displayed at such places where repairs of scaffold are undertaken.

13.8. OPENING

- a. There shall be no opening in any working platform except for allowing access to such working platform;
- b. Wherever opening on a platform is unavoidable, necessary measures for protection against falling of objects or building workers from such platform shall be taken by providing suitable safety nets, belts or any other similar means;
- c. Access from one working platform to another platform on a scaffold, if required, shall be provided with suitable and safe ladder for the use of building workers working on such platforms;

- d. Every opening or shaft in the floor shall be provided with suitable means to protect the fall of a person or material by providing suitable fencing or railing of height not less than 900 mm.

13.9. GUARDRAILS: Every side of a working platform from which a person is liable to fall shall be provided with suitable and safe guardrails and toe board of adequate strength to prevent fall of any building worker, material or tools from such platform.

13.10. SCAFFOLD USED BY BUILDING WORKERS OF DIFFERENT EMPLOYERS

- a. Where a scaffold or a part of a scaffold is used, which has previously been used by another employer for his building workers, such scaffold or part thereof shall be used only after its inspection and examination by a responsible person for ensuring that such scaffold or part thereof is safe and fit for such use;
- b. If any rectification, alteration or modification in a scaffold or part thereof, needed to suit its use, shall be made in consultation with the responsible person.

13.11. PROTECTION AGAINST ELECTRIC POWER LINE:

The contractor shall ensure that all necessary and practical measures for protection are taken to prevent any building worker, working on a scaffold, from coming into contact with the electric wires or dangerous equipment.

13.12. SCREENING NET AND WIRE NETS:

Where a scaffold is erected in an area where the construction activities may pose hazards to pedestrians or vehicular traffic nearby from the falling of objects, wire nets or screening nets shall be used to envelope such scaffold.

13.13. TOWER SCAFFOLD

- a. The height of every tower scaffold used in building or other construction work shall not be more than eight times the lesser to the base dimension of such scaffold;
- b. A tower scaffold shall be lashed to a building or a fixed structure before being used by the building workers;
- c. Any tower scaffold which can be moved or castered shall be –
 - i) Constructed with due regard to the stability and, if necessary, adequately weighted at the base;
 - ii) Used only on plain and even surface; and
 - iii) Has casters provided with positive locking devices to hold such scaffold in position;
- d. No building worker shall remain on board scaffold or leave behind tools and material when it is being shifted from one position to another position.

13.14. GEAR FOR SUSPENSION OF SCAFFOLD

- a. Chains, ropes or lifting gears used for suspension of a scaffold shall be of adequate strength, made of sound material and suitable for the purpose of their use and maintained in good repairs;
- b. Chains, wires, ropes or metal tubes used for the suspension of a scaffold shall be:

- i) Properly and securely fastened to every anchorage point and to the scaffold ledgers of other main supporting members used for the support of such scaffold; and
- ii) So positioned as to ensure stability of the scaffold.

13.15. TRESTLE SCAFFOLD AND CANTILEVER SCAFFOLD

- a. No trestle scaffold shall be constructed with more than three tiers or if its working platform is more than 4.5 m above the ground or floor or other surface upon which such scaffold is erected;
- b. Trestle scaffold shall be designed by professional engineer and shall have the approval of the Engineer in-charge before being taken into use.
- c. No trestle scaffold shall be erected on a suspended scaffold;
- d. No cantilever or jib scaffold shall be used unless it is adequately supported, fixed and anchored on opposite side of its support and have out triggers of adequate length and, where necessary sufficiently, supported and braced to ensure safety and stability of such scaffold;
- e. No working platform resting on bearers let into a wall at one end and without other support shall be used unless such bearers are of adequate strength, braced through the wall and securely fastened on the other side.

13.16. SCAFFOLD SUPPORTED BY BUILDING

- a. No part of a building shall be used as support or part of a scaffold unless such part of the building is made of sufficient strength and made of sound material to afford safe support;
- b. Overhanging eaves gutters shall not be used for supporting scaffold;
- c. Suspended scaffold shall be made of in accordance with the approved standards before being used by the building workers.

13.17. USE OF WINCHES AND CLIMBERS FOR SUSPENDED SCAFFOLD

- a. No scaffold shall be raised or lowered by winches or climbers unless such scaffold is made of sound material, adequate strength and has been tested and certified safe for use of winches or climber by a competent person before being taken into use;
- b. All suspended scaffolds counter-balanced by counter weights shall be of approved types before being taken into use for building or other construction work;
- c. The working platform of a suspended scaffold shall be securely fastened to the building or structure as to be safe and to prevent such platform from swing;
- d. The safe working load that a suspended scaffold can carry, shall be displayed where such scaffold is being used

13.18. SAFETY DEVICES FOR SUSPENDED SCAFFOLD

- a. Every suspended scaffold, raised or lowered by the winches or climbers, shall be provided at each of its suspension point with a safety rope with automatic safety device mounted on each of such rope so that such safety rope with such automatic safety device support the platform of such

scaffold in the event of failure of the primary suspension wire ropes, winches, climbers or any part of the mechanism used for raising or lowering such suspended scaffold;

- b. Provided that the clause (a) shall not apply -
 - i) Where the platform of such scaffold is supported at two independent suspension wire rope at or near each end of such platform so that in the event of failure of one of such suspension wire rope, the other wire rope is capable of sustaining the weights of such platform and its load and prevent it from tilting; or
 - ii) Where a system is incorporated which operates automatically to support the platform of such scaffold and its load in the event of failure of the primary suspension wire rope of such scaffold.

14.0. SAFETY IN THE ERECTION OF STRUCTURAL FRAME & FORMWORK

14.1. GENERAL PROVISION

- a. The trained building worker under the direct supervision of a person, responsible for structural frame and formwork, shall be employed for erection of such structural frame or formwork, dismantling of building and structure and performance of and engineering work formwork, false work and shoring work;
- b. Adequate measures shall be taken to guard against hazards arising from any temporary state of weakness or unsuitability of a structure.

14.2. FORMWORK, FALSE WORK AND SHORING

- a. Formwork and false work shall be so designed, constructed and maintained that such formwork and false work are able to support the load that may be imposed on them;
- b. Such formwork shall be so erected that working platform, means of access, bracings, means of handling and stabilizing could easily be fixed with such formwork.

14.3. ERECTION OR DISMANTLING OF STEEL AND PREFABRICATED

- a. Erection or dismantling of any pre-fabricated structure shall be made safe against danger by using appropriate means such as ladders, gangways or fixed platforms, buckets, boatswains chair or other appropriate means suspended from lifting appliances, safety harness, life lines, catch nets or catch platforms, power-operated mobile working platforms etc.;
- b. The work of erection or dismantling of buildings or structures or formwork or false work or shoring or any other civil engineering work shall be carried out by trained building workers under the supervision of a person responsible for such work;
- c. Steel or prefabricated structures shall be so designed and made that such structures can be safely transported or erected; and weight of each unit of such structures shall be clearly marked on such unit;
- d. The design of each such part shall maintain stability of each part of the structures referred to in clauses above when erected, and to prevent danger, the design shall explicitly take into account –
 - i) The relevant conditions and methods of attachment in the operations of stripping, transport, storing and temporary support during erection of such parts;
 - ii) Safeguards, such as provision of railings with working platforms, and for mounting such railings and platforms easily on the structural steel or prefabricated parts;
- e. The hooks and softer devices built in or provided on the structural steel or prefabricate parts that are required for lifting and transporting such parts shall be so shaped, dimensioned and positioned to withstand the stresses to which such hooks or other devices are subjected;

- f. Prefabricated parts made of concrete shall not be stripped or erected before such concrete has set and hardened sufficiently to the extent provided for in the plans, and such parts are examined by the responsible person for any sign of damage before their use;
- g. Store-places shall be so constructed that –
 - i) There shall be no risk of structural steel or prefabricated parts falling or overturning;
 - ii) Storage conditions shall generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions; and
 - iii) Racks shall be set on firm ground and designed so that units cannot move accidentally in such store-places;
- h. Structural steel or pre-fabricated parts shall not be subjected to stresses prejudicial to their stability while they are stored or transported or raised or set down;
- i. Tongs, clamps and other appliances for lifting structural steel and prefabricated part shall be:
 - i) In such shape and dimensions as to ensure a secure grip without damaging and marked with the maximum permissible load in the most unfavourable lifting conditions; and
 - ii) Structural steel or pre-fabricated parts shall be lifted by such methods and appliances that prevent them from spinning accidentally;
- j. Structural steel or pre-fabricated parts shall be provided with railings and working platforms before raising such parts to prevent any danger of falling of building workers, materials or articles at the time of any work with such parts;
- k. All reasonably practical measures shall be taken to avoid injury to building workers, building structure or equipment while structural steel or pre-fabricated parts are handled or stored or transported or raised or lowered;
- l. Structures shall not be worked on during violent storms or high winds or any other such hazardous situation;
- m. The risk of falling to which building workers, moving on high or sloping girders, may be exposed is limited by all means of adequate collective protection or by the use of a safety harness which shall be well secured to a sufficiently strong supports;
- n. Structural steel parts, which are to be erected at a great height, shall, as far as practicable, be assembled on the ground;
- o. When structural steel or pre-fabricated parts are being erected, a sufficiently extended area underneath the workplace shall be barricaded or guarded;
- p. Steel trusses, which are being erected, shall be adequately shored, braced or guyed until they are permanently secured in position;
- q. Structural members shall not be forced into place by the hoisting machine while any building worker is in such a position that he is likely to be injured by such operation.

14.4. FORMWORK

- a. All formwork shall be properly designed keeping in view the safety of building workers, buildings or structures;
- b. A responsible person for structural frame and formwork shall –
 - i. Inspect and examine the material, timber, structural steel and scaffolding for its strength and suitability before being taken into use;
 - ii. Lay-down procedures to cover all stages of such structural frame and formwork;
 - iii. Supervise such structural frame and formwork;
 - iv. Take all necessary steps or measure to correct any situation with a view to prevent accident or dangerous occurrence during performances of such structural frame and formwork.

14.5. DE-SHORING

- a. When shoring is removed, sufficient props shall be left in place of such shoring to prevent any possible hazard; and
- b. Deshoring shall be adequately braced and tied together with support to prevent any hazard.

15.0. SAFETY IN CONCRETE WORK

15.1. GENERAL PROVISIONS REGARDING USE OF CONCRETE

- a. All construction with the use of concrete or reinforced concrete shall be based on plans including specification of steel and concrete and other material to be used in such construction –
 - i. Giving technical details regarding methods for safe placing and handling of such materials and indicating the type, quality and arrangement of each part of a structure of such construction; and
 - ii. Explaining the sequence of steps to be taken for completion of such construction;
- b. Formwork and shores used for concrete work shall be structurally safe and properly braced or tied together so as to maintain position and shape of formwork or shores;
- c. Formwork structure used shall have sufficient catwalks and other secure access for inspection of such structure if such structure is in two or more tiers;
- d. No machinery or any object should fall below by using wire nets, screen nets etc.

15.2. PREPARATION AND POURING OF CONCRETE AND ERECTION OF CONCRETE STRUCTURE

- a. A building worker handling cement or concrete shall –
 - i) Wear close-fitting clothing, gloves, helmet or hardhat, safety goggles, proper footwear and respirator or mask to protect himself from danger in such handling;
 - ii) Keep as much of his body covered as is required to protect himself from danger in such handling;
 - iii) Take all necessary precautions to keep cement and concrete away from his skin in such handling;
- b. Lime pits shall be fenced or enclosed and filled and emptied by such devices, which do not require workers to go into the pit;
- c. Moving parts of the elevators, hoists screens bunkers, chutes, grouting equipment used for concrete work and of other equipment used for storing, transport and other handling ingredients of concrete shall be securely fenced to avoid contact of building workers with such moving parts;
- d. Screw conveyors used for cement, lime and other dusty materials shall be completely enclosed.

15.3. BUCKETS

- a. Concrete buckets used with cranes or aerial cableways shall be free from projections from which accumulations of concrete could fall;
- b. Movements of concrete buckets shall be governed by signals necessary to avoid any danger by such movements.

15.4. PIPES AND PUMPS

- a. A scaffolding carrying a pipe for pumped concrete shall be strong enough to support such pipe at a time when such pipe is filled with concrete or water or any other liquid and carry the combined load of the all the building workers who may be on such scaffold at such time, safely;
- b. Every pipe for carrying pumped concrete shall be –
 - i) Securely anchored at its end point and at each curve on it;
 - ii) Provided near the top of such pipe with an air release valve;
 - iii) Securely attached to a pump nozzle by a bolted collar or other adequate means;
- c. The operation of concrete pumps shall be governed by standard signals;
- d. Building workers employed around a concrete pump shall wear safety goggles;

15.5. MIXING AND POURING OF CONCRETE

- a. The concrete mixture shall not contain any material, which may unduly affect the setting of such concrete, weaken such concrete or corrode steel used with such concrete;
- b. When dry ingredients of concrete are being mixed in confined spaces such as silos –
 - i) The dust shall be exhausted at the time of such mixing and
 - ii) In case the dust the dust cannot be exhausted, as specified, the workers shall wear respirators at the time of such mixing;
- c. When concrete is being tipped from buckets, building workers shall be kept out of the range of any kickbacks of such buckets;
- d. Loads shall not be dumped or placed on settling concrete.

15.6. CONCRETE PANELS AND SLABS

- a. All parts of a concrete panel or concrete slab shall be hoisted uniformly;
- b. Concrete panels shall be adequately braced in their final positions and such bracings shall remain in such positions until such panels are adequately supported by other parts of the construction for which such panels are used;
- c. Temporary bracings of concrete panels shall be securely fastened to prevent any part of such panels from falling when such panels are being moved.

15.7. STRESSED AND TENSIONED ELEMENTS

- a. Building workers shall not stand directly over jacking equipment while stressing of concrete girders and beams is being done;
- b. A pre – stressed concrete unit shall not be handled except at points on such unit and by the devices specified for such work by the manufacture of such devices;
- c. During transport, pre-stressed concrete girders or concrete beams shall be kept upright by bracing or other effective means;

- d. Anchor fittings for pre-tensioned strands of pre-stressed concrete girders of concert beams are kept in a safe condition in accordance with the instruction of manufacturer of such anchor fittings;
- e. Building workers shall not stand behind jacks or in line with tensioning elements and jacking equipment during tensioning operations of pre-stressed concrete girders of concrete beams;
- f. Building workers do not cut wires of pre – stressed concrete girders or concrete beams under tension before such concrete used of such girder or beams is sufficiently hardened.

15.8. VIBRATORS

- a. A building worker, who is in good physical condition, shall operate vibrators used in concreting work;
- b. All practical measures shall be taken to reduce the amount of vibration transmitted to the operators working in concreting work and
- c. When electric vibrators are used in concreting work
 - i) Such vibrators shall be earthed;
 - ii) The leads of such vibrators shall be heavily insulated; and
 - iii) The current shall be switched off when such vibrators are not in use.

15.9. INSPECTION AND SUPERVISION

- a. A person responsible for a concreting work shall supervise the erection of the formwork, shores, braces and other supports used for such concreting work, make a through inspection of every formwork to ensure that such formwork is safe, regularly inspect the formwork, shores, braces, reshores and other supports during the placing of concrete, keep all records of inspections referred to above at the workplace relating to such inspection and produce them for inspection upon the demand.
- b. Any unsafe condition, which is discovered during the inspections, shall be remedied immediately.

15.10. BEAMS, FLOORS AND ROOFS

- a. Horizontal and diagonal bracings shall be provided in both longitudinal and transverse direction as may be necessary to provide structural stability to formwork used in concreting work and shores used in such concreting work shall be properly seated on top and bottom and secured in their places;
- b. Where shores used in concreting work rest upon the ground, base plates shall be provided for keeping such shores firm and in level;
- c. Where the floor to ceiling height of a concreting work exceeds 9 m or where the formwork deck used in such concreting work is supported by shores constructed in two or more tiers, or where the dead, live and impact loads on the formwork used in such concreting work exceed 700 kilogram per m², the structure of such formwork shall be designed by a professional engineer in the relevant field and the specifications and drawings of such formwork kept at such construction site and produced on demand.

- d. Where a professional engineer designs the structure of the formwork used in concreting work, such engineer shall be responsible for the supervision of construction and the stability of such structure.

15.11. STRIPPING

- a. Stripping of formwork used in concreting work shall not commence until the concrete on such formwork is fully set, examined and certified to this effect by the responsible person and record of such examination and certification is maintained;
- b. Stripped forms in concreting work shall be removed or stock piled promptly after stripping from all areas in which building workers are required to work or pass;
- c. Protruding nail, wire ties and other formwork accessories not required for subsequent concreting work shall be pulled, cut or otherwise made safe.

15.12. RE-SHORING

- a. Re-shoring used in concreting work shall be provided to a slab or beam for its safe support after its stripping or where such slab or beam is subjected to superimposed loads due to construction above such slab or beam;
- b. The provisions applicable to shoring in a concreting work shall also be applicable to reshoring in such work or pass.

16.0. SAFETY IN CONSTRUCTION, REPAIR & MAINTENANCE OF STEEP ROOFS

16.1. WORK ON STEEP ROOFS:

All practicable measures shall be provided to protect the building workers against sliding when carrying outwork on steep roofs.

16.2. CONSTRUCTION AND INSTALLATION OF ROOFING BRACKETS

- a. Roofing brackets shall be constructed to fit the pitch of steep roof and such brackets shall be used to provide level working platform;
- b. Roofing bracket shall be secured in its place by nailing pointed metal projections attached to the underside of such bracket and securely driven into a steep roof on which it is used or secured by a rope passed over the ridgepole and tie of such roof.

16.3. CRAWLING BOARDS

- a. All crawling boards used for work on steep roofs shall be of adequate strength, made of sound material and of the type approved for the purpose of their use;
- b. Crawling boards shall be kept in good repairs and inspected by a responsible person before being taken into use;
- c. Crawling boards shall be secured to a steep roof on which it is used by ridge hooks or other effective means;
- d. A firmly fastened lifeline of adequate strength shall be strung beside each crawling board throughout its length while using such crawling boards.

17.0. SAFETY IN CATCHES PLATFORMS, HOARDINGS & CHUTES

17.1. CATCH PLATFORM

- a. Catch platform shall not be used for storage of material or as a working platform;
- b. Catch platform shall at least be of 2 m wide and inclined so that the position of outer edge of such platform is 1500 mm higher than the inner edge;
- c. The open end of catch platform shall be properly fenced to the height not less than 1 m.

17.2. HOARDINGS:

Hoardings shall be constructed when the Registering Authority / Assistant Labour Commissioner considers it necessary for protection of building workers and directs such employer to construct such hoardings.

17.3. CHUTES, ITS CONSTRUCTION AND USE

- a. Wooden or metal chutes which are at an angle of more than 45° to the horizontal and used for the removal of materials shall be closed on all sides except at their openings used for receiving or discharging of materials or articles;
- b. All openings of chutes except their top openings shall be closed when not in use;
- c. Every chute –
 - i. Shall be constructed of sound material, adequate strength and suitable for the purpose it is intended for use;
 - ii. Exceeding 12 m in height shall be constructed in accordance with the design and drawings of professional engineer for such;
 - iii. A suitable warning notice shall be displayed at conspicuous locations, written in Hindi and in a local language, at the discharge end of every chute;
 - iv. Shall be cleared when debris has accumulated to a height, which can pose danger to building worker, but such clearance shall be done in no case less frequently than once a day.

18.0. SAFETY IN WORK ON OR ADJACENT TO WATER

18.1. TRANSPORT OF WORKERS BY WATER

- a. When any building worker has to proceed to or from any workplace by water for purposes of carrying on a building or other construction work, proper measures shall be taken to provide for his safe transportation and vessels used for such purpose shall be in charge of a responsible person, properly equipped for safe navigation and maintained in good condition;
- b. Maximum number of persons which can be safely carried in a vessel shall be marked plainly and conspicuously on such vessel and such number shall not be exceeded during use of such vessel for carrying persons;
- c. Adequate protecting shall be provided to the building workers in such vessel from inclement weather;
- d. Such vessel shall be manned by adequate and experienced crew;
- e. In case the bulwarks of such vessel are lower than 60 cm from the level of the deck of such vessel, the open edge of such bulwarks shall be fitted with suitable fencing to a height of at least 1 m above such deck and the post and stanchions and similar parts used in such fencing shall not be spaced more than 2 m;
- f. The number of life buoys on deck of such vessel shall at least be equal to the number of crew members of such vessel and shall not be less than two;
- g. All life buoys on deck of such vessel shall be kept in good state of maintenance and so placed that if such vessel sinks then they will remain afloat and one of such buoys shall be within the immediate reach of the Steersman of such vessel and another is situated after part of such vessel; and
- h. The position of the steersman of the vessel shall be such that he has a reasonably free view of all sides.

18.2. PREVENTION FROM DROWNING

- a. Where, on or adjacent to the workplace of any contraction site, there is water into which a building worker employed for work on such site, in the course of his employment, may fall and has the risk of drowning, suitable rescue equipment shall be provided and kept in an efficient state of ready use and measures shall be taken to arrange for the prompt rescue of such building worker from the danger of drowning and where there is a special risk of such fall from the edge of adjacent land or from a structure adjacent to or above the water, or from floating stage on such water, secure fencing shall be provided near the edge of such land, structure or floating stage, as the case may be, to prevent such fall, and such fencing may be removed or allowed to remain unerected for the time and to the extent necessary for the access of building workers to such work or the movement of material for such work;
- b. For handling rescue equipment, at least two persons knowing diving should be available at such sites.

19.0 SAFETY IN COFFERDAMS & CAISSONS

19.1 EVERY COFFERDAM AND CAISSON SHALL BE

- 19.1.1 Of good construction, sound material and of adequate strength, provided with adequate means for workers to reach safely at the top of such cofferdam or caisson in the event of an in rush of water and safe means of access to every place where workers shall be employed;
- 19.1.2 Work relating to construction, positioning, modification, dismantling of cofferdams or caissons shall be carried out under the supervision of a responsible person and inspected by the responsible person at the specified intervals;
- 19.1.3 A worker shall be allowed to work in a cofferdam or caisson after such cofferdam or caisson has been inspected and found safe by responsible person within such preceding period as approved and a record of such inspection maintained.

19.2 WORK IN COMPRESSED AIR IN A COFFERDAM OR CAISSON SHALL BE

- 19.2.1 Carried out in accordance with the procedure laid down;
- 19.2.2 Carried out by such building workers who have completed eighteen years of age and are medically examined and found fit for the work;
- 19.2.3 Carried out under the supervision of a responsible person;
- 19.2.4 If the work in cofferdam or caisson is carried out in shifts, a record of the time spent by each worker in each such shift for carrying out the work shall be maintained in a register with particulars or time taken for the compression of such building worker, if any;
- 19.2.5 At every work site or project in a cofferdam or caisson, where workers are employed to work in compressed air environment, a construction medical officer assisted by a nurse or trained first-aid attendant, shall be available at all times and there shall be one standby reserve compressor to meet the emergency.

19.3 PRESSURE PLANT AND EQUIPMENT

- 19.3.1 Pressure plant and equipment for which it is used shall be –
- 19.3.2 Properly maintained in good repairs and working condition and fitted with a suitable safety valve or other effective device to provide maximum safe discharge pressure from being exceeded at any time; a suitable pressure gauge with a dial range not less than 1.5 time and not exceeding twice the maximum working pressure, easily visible and designed to show at all times, the internal pressure in kilogram per square centimeter and marked with the maximum safe working pressure, a suitable stop valve or valves by which the pressure plant or the system of the pressure plant may be isolated from the source supply of pressure or otherwise;
- 19.3.3 Every pressure plant or equipment shall be thoroughly examined by the competent person, externally, once in every period of six months; internally, once in every period of twelve months; and by hydraulic test, once in a period of four years.

20. SAFETY IN DEMOLITION WORK

20.1 PREPARATION

- 20.1.1 All glass or similar material or article in exterior openings shall be removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines put off and suitably capped and the concerned department of the appropriate authority informed and permission obtained wherever required before commencing;
- 20.1.2 Wherever it is necessary to maintain water, gas or electric line or power during such demolition, such line shall be so located or protected with substantial coverings so as to protect it from damage and to afford safety to the building workers and the general public.

20.2 PROTECTION OF ADJACENT STRUCTURES

20.2.1 Examination of walls etc. of adjacent structures –

- i) During demolition process, the contractor shall examine the walls of all structures adjacent to the structure to be demolished to determine the thickness, method of support to such adjacent structures and;
- ii) In case, such employer has reason to believe that any of such adjacent structure is unsafe or may become unsafe during such demolition process, he shall not perform demolition activity unless stability to such unsafe adjacent structure from collapsing has been taken. All roads and open spaces adjacent to the site of demolition work shall be closed or suitably protected by bracketing.

20.3 DEMOLITION OF WALLS, PARTITIONS, ETC.

- 20.3.1 Any demolition of walls or partitions shall be proceeded in a systematic manner as per the standard safe operating practices approved and all work above each tier of any floor beams shall be completed before the safety of the supports of such beam is impaired;
- 20.3.2 Masonry shall be neither loosened nor permitted to fall in such masses or volume or weight as to endanger the structural stability of any floor or structural supports;
- 20.3.3 No wall chimney or other structure or part of a structure shall be left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration;
- 20.3.4 In the case of demolition of exterior walls by hand, safe footing shall be provided for the workers employed in, such walls or partitions, which are to be demolished by hand shall be not left standing more than one storey high above the uppermost floor on which persons are working.

- 20.4 **METHOD OF OPERATION:** The contractor shall ensure that debris, bricks and other materials or articles are removed by means of chutes, buckets or hoists and through openings in the floors.

20.5 ACCESS TO FLOOR

- 20.5.1 Safe access to and egress from every building shall be provided at all times in the course of demolition by means of entrances hallways, stairways or ladder runs which shall be so protected as to safeguard the workers using such means from falling material or articles;

- 20.5.2 Demolition of structural steel etc. shall be demolished column by column and tier by tier and every structural member, which is being demolished, shall not be under any stress, and such structural member shall be suitably lashed to prevent it from any uncontrolled swinging, dropping or falling or falling;
- 20.5.3 Large structural members shall not be thrown or dropped from the building, but carefully lowered by adopting suitable safe method;
- 20.5.4 Where a lifting appliance like a derrick is used for demolition, the floor on which such lifting appliance rests shall be completely planked over or supported and such floor shall be of adequate strength to sustain bearing load for such lifting appliance and its operation.

20.6 STORAGE OF MATERIAL OR ARTICLE

- 20.6.1 No materials or articles shall be not stored or kept on platform, floor or stairways of a building being demolished, provided that this clause shall not apply to the floor of a building when such floor is of such strength as to support safely the load to be superimposed by storing such material or articles;
- 20.6.2 No access to any stairway or passageway shall be affected or blocked by storing any material or article;
- 20.6.3 Suitable barricades shall be provided so as to prevent materials or articles from sliding or rebounding into any space used by the workers.

20.7 FLOOR OPENINGS:

Every opening used for the removal of debris from every floor which is not closed to access, except the top or working floor, shall be provided with an enclosure from such floor to its ceiling, or such opening is so barricaded that no building worker shall access to within a horizontal distance of 6.0 m from such opening through which debris is being dropped.

20.8 INSPECTION:

A person responsible for demolition work shall make continuous inspections during demolition process so as to detect any hazard resulting from weakened or deteriorated floors or walls or loosened materials or articles, and that no building worker shall be permitted to work where such hazard exist unless remedial measures like shoring or bracing shall be taken to prevent such hazards.

20.9 WARNING SIGNS, BARRICADES, ETC.

- 20.9.1 Barricades and warning sign shall be erected along every side throughout the length and breadth of a building or other construction work to be demolished to prevent unauthorized persons from entering into the during demolition operations;
- 20.9.2 During the demolition of an exterior masonry wall or a roof from a point more than 12 m above the adjoining ground level of such wall or roof, if persons below such wall or roof are exposed to falling objects, suitable and safe catch platform shall be provided and maintained at a level not more than 6 m below the working level except where an exterior built-up scaffold is provided for safe and adequate protection of such persons;
- 20.9.3 Suitable and standard warning signs shall be displayed or erected at conspicuous places or position at the workplace;

20.10 MECHANICAL METHOD OF DEMOLITION

20.10.1 The following requirements shall be fulfilled in case the mechanical method of demolition like use of swinging weight, clamshell bucket, power shovel, bulldozer or other similar mechanical methods are used for the purpose of demolition namely –

- i) The building or structure or structure or remaining portion thereof shall be not more than 12 m in height;
- ii) Where a swinging weight is used for demolition, a zone of such demolition having a radius of at least 1.5 times the height of the structure of portion thereof being demolished shall be maintained around the points of impact of such swinging weight;
- iii) Where a clamshell bucket is being used for demolition, a zone of demolition shall be maintained within eight metres of the liner of travel of such bucket;
- iv) Where other mechanical methods are being used to affect total or partial collapse of a building or other construction work, there shall be maintained, in the area into which the affected portion of such building or other construction work may fall, a zone of demolition at least 1.5 times the height of such affected portion thereof; and
- v) No person other than building workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition, which shall be provided with substantial barricades.

21. FIRE EXTINGUISHERS & OTHER APPLIANCES OF FIRE FIGHTING

21.1 FIRE EXTINGUISHERS & OTHER MEANS OF PREVENTION AND PROTECTION

21.1.1 Every contractor shall have a fire protection and prevention plan developed and implemented keeping in view the following:

- i) The specific work practices requiring fire control measures;
- ii) Response measures to be taken in case of fire;
- iii) Equipment required;
- iv) Personnel requirements and responsibilities;
- v) Schedules of daily and weekly inspection;
- vi) Open flames and fires are prohibited in all underground construction;
- vii) Readily visible signs to be posted in the fire prone/inflammable/explosive areas prohibiting smoking use of open flames and other hot work.
- viii) A system of Permit-to-Work.

27.1.2 For the protection of the workers from the outbreak of fire, the contractor shall Provide, maintain and regularly inspect the Fire extinguishing equipment, which shall be sufficiently provided to extinguish any probable fire;

Suitability of portable fire extinguishers			
Class of fire	Type of extinguisher		
	Water	DCP	CO ₂
A	Yes	Yes	Yes
B	No	Yes	Yes
C	No	Yes	Yes
D	No	Yes	Yes
Electrical	No	Yes	Yes

27.1.3 Ensure availability of an adequate supply of water at ample pressure;

27.1.4 Make available

- i. Adequate number of trained persons required to operate the fire extinguishing equipment;

- ii. Properly maintain Fire extinguishing equipment and inspect them at regular intervals of not less than once in a year by the responsible person and a record of such inspections maintained;
- 27.1.5 Portable fire extinguishers provided in the operator's cabin of earthmoving machinery, material handling systems, construction equipment etc. shall be regularly inspected, maintained and replenished/refilled;
- 27.1.6 The operators and the helpers of such equipment shall be trained in the methods operating the equipment and fighting the fire effectively;
- 27.1.7 All combustion engine power equipment shall be so located that the exhausts are well away from combustible material;
- 27.1.8 No smoking shall be allowed at or in the vicinity of operations, which constitute fire hazards and shall be conspicuously posted with No smoking or open flame **signs**;
- 27.1.9 In the flammable environment as described in IS: 9570, the electrical fittings and equipment shall be of flame proof type conforming to IS: 2206 & IS: 2148;
- 27.1.10 Arrangements shall be made to contain sparks generated during welding, cutting or other operations and spark shall not be allowed to fall down on combustible material kept below; All means of exit shall be kept free of obstruction at all times;
- 27.1.11 Appropriate type of fire extinguishers according to IS: 5698 shall be kept in fully charged condition at the places which have potential risk of fire;
- 27.1.12 The contractor shall educate his or his sub-contractors' men working in the vicinity of fire risk, on how to operate these equipment and know in particular circumstances which type of extinguishers is to be used;
- 27.1.13 The contractor shall take full responsibility for the upkeep and replenishment/refilling of the fixed and portable fire extinguishers.

APPENDIX

Annexure I

IMPORTANT INDIAN STANDARDS RELATED TO SAFETY

Personal Protection

- IS: 1179-1967 Equipment for eye and face protection during welding
- IS: 4770-1991 Rubber gloves for electrical purposes
- IS: 8519-1977 Guide for selection of industrial safety equipment for body protection
- IS: 8520-1977 Guide for selection of industrial safety equipment for eye, face & ear protection
- IS: 8807-1978 Guide for selection of safety equipment for protection of arms and hands
- IS: 1224-1985 Safety shoes
- IS: 2925-1984 Safety helmets
- IS: 8940-1978 Code of practice for maintenance and care of industrial safety equipment eye and face protection
- IS: 8990-1978 Code of practice for maintenance and care of industrial safety clothing
- IS: 10667-1983 Guide for selection of industrial safety for protection of foot and leg
- IS: 816-1969 Code of practice for safety and health requirements in electric and gas welding and cutting operations
- IS: 818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations
- IS: 7194-1994 Assessment of noise exposure during work for hearing conservation purposes

Civil Engineering Construction

- IS: 2750- 1967(Part II) Steel scaffolds
- IS: 875-1987 Structural safety of building: loading standards
- IS: 4014-1967 Code of practice for steel tubular scaffolding
- IS: 3696 Safety code of scaffolds and ladders
- IS: 4138-1977 Safety code for working in compressed air
- IS: 4912-1978 Safety requirements for floor and wall openings, railings and toe boards
- IS: 7293-1974 Safety code for working with construction machinery
- IS: 9944-1992 Recommendations on safe working load for natural and man-made rope slings
- BS: 1129 Portable timber ladders, steps, Trestles & lightweight staging
- BS: 1139 Metal scaffolds
- BS: 5973 Code of practice for access & working scaffolds
- BS: 5974 Code of practice for temporary installed scaffolds and access equipment
- BS: 5975 Code of practice for falsework

Fire Protection

- IS: 2190-1992 Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers
- IS: 5896 Code of practice for selection, operation and maintenance of fire-fighting appliances

IS: 8433-1984 Code of practice for dissolved acetylene cylinders

Electrical

IS: 3043-1987 Code of practice for earthing

IS: 5424-1969 Rubber mats for electrical purposes

IS: 3646 (Part II) Artificial lightings

IS: 2148 & IS: 2206 Flame proof electrical fittings

Machinery

IS: 1860-1980 Code of practice for installation, operation and maintenance of electric passenger and goods lifts

IS: 1991-1987 Safety requirements for the use, care and protection of abrasive grinding wheels

IS: 5903-1970 Safety devices for gas cylinders

IS: 8216-1976 Guide for inspection of lift wire ropes

IS: 8964-978 Recommendations for safety conditions for woodworking machines

IS: 9474-1980 Principles of mechanical guarding of machinery

IS: 11461-1985 Code of practice for compressors safety

IS: 13367-1992 Code of practice for safe use of cranes

BASIC STRUCTURE OF SAFETY PLAN

- 01- Safety Policy
- 02- When was the Safety Policy last reviewed
- 03- Details of implementation procedure / methods to implement Safety Policy / Safety Rules
- 04- Qualification & Experience of Safety Officers
- 05- Review of Accidents analysis - Methods to ensure safety & health and steps identified for prevention of accidents
- 06- Unit/site Executive responsible for ensuring safety at various levels in the workplace
- 07- List of Employees trained in safety at the commencement of execution of the job; details of training – its module and contents
- 08- Safety Training Targets, Schedules, Methods to be adopted for providing safety training to all employees
- 09- Details of checklists for different jobs/ work & responsible persons to ensure Compliance
- 10- Regular Safety Inspection Methods and Periodicity and the list of members authorized
- 11- Risk Assessment, Safety Audit by professional agencies, their Periodicity
- 12- Implementation of recommendations of Audit / Inspections. - Procedures for implementation & follow-up
- 13- Provision for treatment of Injured persons at work site
- 14- Review of overall safety by top Management and Periodicity
- 15- System for implementation of statutory provisions.
- 16- Issue of PPE to employees, Periodicity / stock on hand, etc.

Signature
Head of Organization
With Date & Stamp

Annexure - III

CONFINED SPACE WORK PERMIT

Date of Work :		Initiator:		Permit No.:	
Description of work :					
Name of person supervising:			Dept./Function:		
Names of workmen involved in the job :					
1		2			
3		4			
Exact Location of Work:					
JSA Reference No.					
Job Instruction & Confirmation Sheet Ref. No					
Valid From : Time Date: To Time: Date:					
Other relevant information (if any)					
Initiated by Engineer / Supervisor of Agency			Checked by Agency Safety Representative		
Name				Name	
Signature				Signature	
Date				Date	
Check list for Authorization of Work Permit					
Minimum and Mandatory Precautions					Y/ N / NA
1	Permit form filled in completely?				
2	Have wind, atmospheric, and work area conditions (e.g. cold, hot, snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?				
3	All necessary Personnel Protective Equipment like Breathing Set, Waist Rope, Light Mounted Helmet etc. is put on by all the workmen?				
4	A lifeline, a rope tied on the safety belt of the person entering the confined space is provided?				
5	All practicable measures are taken to ensure that the atmosphere inside is not deficient in oxygen and does not contain flammable vapors and no hazardous gases like H ₂ S. (Open at least 2 manholes & keep for 2 hours)?				
6	One fully trained person is stationed at ground level/outside to assist the inside workers and emergency contact No's available?				
7	All the workers trained for emergency?				

8	Safe means of access and egress provided?		
9	Is the suitable fire extinguisher available at work location?		
10	Are they Using only 24V lamps & working tools inside the confined space?		
Following additional precautions need to be taken before the start of the work			
Permit Issued By:			
	Approved by Principal Agency work in charge		Endorsed by Principal Agency HSE Dept
Name			
Signature			
Date			
Permit Close Out by: Name & Signature (Principal Agency)			
Date :		Time :	
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.			

HOT WORK PERMIT

Date of Work :		Initiator:		Permit No.:	
Description of work :					
Name of person supervising:			Dept./Function:		
Names of workmen involved in the job :					
1		2			
3		4			
Exact Location of Work:					
JSA Reference No.					
Job Instruction & Confirmation Sheet Ref. No					
Valid From : Time Date: To Time: Date:					
Other relevant information (if any)					
Initiated by Engineer / Supervisor of Agency			Checked by Agency Safety Representative		
Name				Name	
Signature				Signature	
Date				Date	
Exact location of work					
Relevant information					
Check list for Authorization of Work Permit					
Minimum and Mandatory Precautions					Y/ N / NA
1	Permit form filled in completely?				
2	Form filled in correctly and in full.				
3	Has the work area been inspected for any abnormalities - specify on wind, atmosphere, surroundings, etc.				
4	Are the necessary PPE provided and do the workmen know their use?				
5	Is the fitter, experienced and knowledgeable enough to carry out the job?				
6	Area has to be cleared of any flammables and combustible material.				
7	Electrical equipment to be protected and grounded.				
8	Are fire-fighting equipment - extinguishers, water, sand buckets etc, located nearby for ready in case of any mishap?				
9	Gas cylinders in upright state/ trolleys/ flash-back arrestors/ hose condition/ NRVs, etc.				
10	Is the area easily accessible?				

Additional precautions to be taken:		
This permit is valid only for one week. A fresh hot work permit has to be taken for continued works for the next week.		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

PERMIT FOR LIFTING OF MATERIAL

Date of Work :	Initiator:	Permit No.:
Description of work:		
Name of person supervising:		Dept./Function:
Names of workmen involved in the job :		
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time Date: To Time: Date:		
Other relevant information: (If any)		
Initiated by Engineer / Supervisor of agency		Checked by Agency Safety Representative
Name		Name
Signature		Signature
Date		Date
Check list for Authorization of Work Permit		
1	Details of type of crane(s) to be used?	
2	Name of Lift Co-ordinator, Rigger/Crane Operator?	
3	Adequate and suitable lifting gears available and in good condition	
4	Have soil, wind, atmospheric, and work area conditions (e.g. cold, hot , snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?	
5	Lifting Equipments, Lifting gears and Slings are tested and certified?	
6	Are all operators trained, competent and healthy (Having Licenses / Experience Certificate)?	
7	Are all the examinations and tests carried out on the equipment (Crane) and certified by competent persons?	
8	Is the safe working load (SWL) marked on all lifting tools & tackles?	
9	Lifting area cordoned off?	
10	Tag lines provided to control the swing of load?	
11	Load tied properly and secured against toppling and falling?	
12	Signalman/Rigger is provided and competent?	
13	Proper communication available between operator and rigger?	
14	Is the vehicle for transportation adequate for the load?	

Following additional precautions need to be taken before the start of the work:			
Permit Issue b By:			
Approved by Principal agency work incharge		Endorsed by main agency HSE Dept	
Name		Name	
Signature		Signature	
Date		Date	
Permit Close Out by: Name & Signature (Main agency)			
Date :		Time :	
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.			

WORKING AT HEIGHT PERMIT

Date of Work :	Initiator:	Permit No.:
Description of work :		
Name of person supervising:		Dept./Function:
Names of workmen involved in the job :		
1	2	
3	4	
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time Date: To Time: Date:		
Other relevant information		
Initiated by Engineer / Supervisor		Checked by Agency Safety Representative
Name		Name
Signature		Signature
Date		Date
Check list for Authorization of Work Permit		
Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Work area below is temporarily cordoned/barricaded	
3	The scaffold erected has pipes and clamps in good condition.	
4	Diagonal / lateral bracings pipes are provided to ensure stability	
5	Access ladder is provided to reach the work location	
6	Planks / sheet used in temporary platform are in good condition	
7	Planks / sheets are tied properly using binding wire	
8	Temporary platform is having temporary side railing	
9	Workers are wearing Helmet, Shoes & Safety belt in good condition.	
10	For Anchoring of safety belt at height rigid support / life rope line is provided	
11	Experienced workers are engaged for work	
12	Portable elect equip/fibre body checked for its healthiness including earthing	
13	The sling / pulley blocks / ropes are tested for fitness	

14	Workers are briefed on Safety Precautions to be taken	
	Power hand tools used at eight are connected through 30mA ELCB.	
Following additional precautions need to be taken before the start of the work		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

DEFINITIONS

1. **Building or other construction work:** means the construction, alteration, repairs, maintenance or demolition, of or, in relation to, buildings, streets, roads, railways, tramways, airfields, generation, transmission and distribution of power, water works, oil and gas installations, electric lines, tunnels, bridges, viaducts, pipelines, towers, cooling towers and such other work as may be specified.
2. **Building worker:** means a person who is employed by a contractor to do any skilled, semi-skilled or manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment be expressed or implied, in connection with any building or other construction work;
3. **Establishment:** means an establishment who or which employs building workers in any building or other construction work, and includes an establishment belonging to a contractor;
4. **Contractor:** means a person who undertakes to produce a given result for any establishment, other than a mere supply of goods or articles of manufacture by the employment of building workers or who supplies building workers for any work of the establishment, and includes a sub-contractor or any other agency engaged on his behalf;
5. **Employer:** in relation to an establishment, means the owner thereof that is the contractor himself.
6. **Competent Person:** means a person so approved by the Central Government who belongs to a testing establishment in India possessing adequate qualification, experience and skill for the purpose of testing, examination or annealing and certification of lifting appliances, lifting gears, wire ropes or pressure plant or equipment;
7. **Responsible Person:** means a person appointed by the employer to be responsible for the performance of specific duty or duties and who has sufficient knowledge and experience and the requisite authority for the proper performance of such duties;
8. **Danger:** means danger of accident or of injury or danger to health;
9. **Hazard:** means danger or potential danger;
10. **Hazardous substance:** means any substance, which due to its explosiveness, inflammability, radioactivity, toxic or corrosive properties and similar hazardous characteristics may Cause injury; or Affect adversely the human system; or Cause loss of life or damage to property or environment;
11. **Hazardous Process:** comprises roof work, steel erection, and work under and over water, demolition and work in confined space;

- 12. National Standard:** means standards as approved by the Bureau of Indian Standards (BIS) and in the absence of such standards, the standards approved by the Central Government for a specific purpose;
- 13. Lifting Appliance:** means a crane, hoist, derrick, winch, jack, pulley block or other equipment used for lifting materials, objects or building workers;
- 14. Lifting gear:** means ropes, chains, hooks, slings and other accessories of a lifting appliance;
- 15. Safe Operating Practice:** Means the practice followed in building and construction activities for the safety of workers and for safe operation of machinery and equipment used in such activities. Such practices shall conform to all or any of the following:
- Relevant Standards approved by BIS;
 - National Building Codes;
 - Manufacturer's instruction on safe use of equipment and machinery;
 - Code of practice on safety in construction industry published by International Labour Organization .
- 16. Safe working load:** in relation to an article of lifting gear or lifting appliance, means the load which is the maximum load that may be imposed on such article or appliance with safety in the normal conditions as assessed and certified by a competent person;
- 17. Workplace:** means all places where building workers are required to be present or to go for work and which are under the control of an employer;
- 18. Personal Protective Equipment (PPE):** are the protective devices made available for individual or collective use of the workers likely to be affected by the hazards of the workplace or process;
- 19. Construction & Erection Manual (E&C) Rules:** all references to E&C Manual shall mean the Construction & Erection Rules that are detailed hereunder;
- 20. Engineer in-charge:** All references to the Engineer in-charge shall mean the person in-charge of a building and construction of the NTPC.
- 21. Interpretation of words not defined:** words and expressions not defined or used in this Manual shall have the same meaning as generally assigned in common engineering practices

SECTION – VI

TECHNICAL SPECIFICATIONS & DRAWINGS (TS)

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS				
1.00.00	INTENT OF SPECIFICATION				
1.01.00	The intent of the specification is for supply, construction/ erection for CW System civil works package. The works are to be executed within the boundaries of Khurja Thermal Power Project, Stage-II (2x660MW) of THDC Limited.				
1.02.00	The Technical Specification covers the technical requirements for the supply/ construction/ fabrication and erection/ installation of complete civil, structural and architectural works as applicable. Supply of all construction materials including cement, reinforcement steel and structural steel shall be in Bidder's scope. The works shall have to be carried out both below and above ground level. Broad scope of work is specified herein in subsequent clauses.				
1.03.00	The Technical Specifications are intended for the general description of the works, quality and workmanship. The technical specification is however not intended to cover the minute details of works and workmanship. The execution of works and the workmanship shall be according to the description given in the Schedule of Quantities and relevant Indian standard codes. In absence of relevant Indian standards codes, the execution of works and the workmanship shall be according to the best prevailing engineering practices and/ or to the recommendations of relevant British and/ or American standards and/ or to the instructions of Engineer.				
1.04.00	The work to be carried out as per the above broad scope shall be all in accordance with the requirements, conditions, appendices etc. given in Technical Specifications (Parts A, B, C) together with those stated in other Sections/ Sub-sections of Bid Documents such as 'General Conditions of Contract', 'Special Conditions of Contract', 'Tender Drawings' and 'Schedule of Quantities' which shall be considered as a part of this volume as if completely bound herewith. It is not the intent to specify herein all aspects of construction, nevertheless, the civil works shall conform in all aspects to high standard of engineering, design and workmanship acceptable to the Employer, who will interpret the meaning of the specification and drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/ or applicable Indian/ International standards mentioned elsewhere in this specification.				
1.05.00	Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarifications should be sought within the time period as stipulated in the bidding documents. Bidder's offer should not carry any sections like clarifications, interpretations and/ or assumptions. Bidders are also requested to visit site & understand the prevailing site conditions.				
1.06.00	Whenever a material or article is specified or described by the name or a particular brand, manufacturer or trade mark, the same shall be understood as establishing type, function and quality desired. Other manufacturer's products may also be considered provided sufficient information is furnished so as to enable the Employer to determine that the products are equivalent to those named.				
1.07.00	Before submitting his bid, the bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may				
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CLAUSE NO.		SCOPE AND SPECIAL TECHNICAL REQUIREMENTS		
1.08.00	influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer.			
1.09.00	In case of any conflict/ contradiction among various volumes/ sections/ annexures/ chapters/ appendices/ tender drawings of bid documents, the same shall be referred to the Employer for clarifications whose decision shall be final and binding. No extra claims shall be allowed on this account.			
1.09.00	The Technical Specification is divided into three (03) parts, as given hereunder:			
	Part - A	Scope and Special Technical Requirements		
	Part - B	General Technical Specification.		
	Part - C	Quality Assurance and Inspection for Civil works		
	Part - A includes the following appendixes:			
	Appendix - I	List of tender drawings		
	Appendix - II	List of suggested plants and equipment machinery required to be deployed by contractor at site		
	Appendix - III	Borelogs		
	Part - B is divided into following Sections:			
	Section - 1	Excavation and Filling		
	Section - 2	Cast-In-Situ Concrete and Allied Works		
	Section - 3	Fabrication and Erection of Structural Steel Works		
	Section - 4	Masonry, Sheeting and Allied Works		
	Section - 5	Finishing and Allied Works		
	Section - 6	Water Supply, Drainage and Sanitation		
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
	Section - 7	Stoplog gates, Trash rack and lifting beams etc.		
	Section - 8	Special Items		
2.00.00	TENDER DRAWINGS			
2.01.00	The list of Tender Drawings listed in Appendix-I of the Technical Specification supplements the requirements specified in these Technical Specifications. The tender drawings provide a general idea about the works to be performed under the scope of this contract. These are preliminary drawings for "Tender purpose only" and are by no means the final drawings and do not show the full range of work under the Scope. The details given in the Tender Drawings are tentative and likely to change during detailed engineering. No compensation whatsoever shall be payable to the Contractor on account of these changes. The Work has to be executed strictly in accordance to the drawings marked "Released for construction" and/ or "Released for preparation of fabrication drawings", by the Engineer, including revisions if any. The drawings would be issued to the contractor progressively during the execution of the contract.			
3.00.00	SCOPE OF WORK			
3.1.1	The broad scope of work shall include execution of complete civil, structural and architectural works related to but not limited to the following areas, systems, structures/ substructures, buildings and facilities:			
	A.	CW System Civil works		
	a.	Complete civil, structural and architectural works associated with CW pump house alongwith steel superstructure and metal sheeting at roof including substructure pump foundations, maintenance bay, forebay, Transition zone, flow smoothening devices/ structures required as per the sump model tests (Model test in Owner's scope) for CW Pump house sump, Switchgear room and Control room Building etc.		
	b.	Complete civil work for CW channel from the terminal point at IDCTs up to CW pump house, Forebay, Transition zone and any other flow smoothening devices/ structures required.		
	c.	CW pump house including concreting of first stage & second stage embedment for stop log gates & trash racks in each pump bay.		
	d.	Complete civil work for laying MS pipes including excavation, backfilling, encasement of CW pipes with P.C.C./R.C.C.		
	e.	Civil and structural works for manhole chambers etc.		
	f.	Civil works for RCC pits for pitot tube and annubar, etc.		
	g.	Civil works for storm water drains around CW pump house area including switchgear room and control room.		
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
B.	Raw Water pump house			
	a.	Complete civil, structural and architectural works associated with Raw Water Pump House (RWPH) with steel superstructure and metal sheeting at roof including maintenance bay, Sump, connection with reservoir outlet pipes, pump foundations, Switchgear room and control room Building etc.		
	b.	Complete civil works for laying MS pipes from terminal point near the existing reservoir embankment, to raw water pump house including excavation, backfilling, encasement of CW pipes with P.C.C./R.C.C..		
	c.	Raw water pump house including concreting of first stage & second stage embedment for stop log gates & trash racks in each pump bay.		
D.	Common facilities			
	a.	Complete civil and structural works associated with CW steel pipe from CW pump house to terminal point at Transformer yard and from terminal point at Transformer yard to the IDCTs. The pipes are to be concrete (RCC/PCC) encased below ground.		
	b.	Civil & Structural works for all culverts/bridge at crossing of CW channels & for pipe/foot bridge etc., including all culverts for pipeline crossings across roads, embankments, concrete encasement for buried pipelines.		
	c.	Civil and structural works for all pipe and cable support structures, pipe and cable trenches with covers, crossings etc.		
E.	Disposal of excavated surplus earthwork within plant boundary including compaction.			
	a.	Painting of all steel structures and the pipes above the ground, corrosion protection measures of all the buried/encased pipes.		
	b.	Civil works for earthing mat around pump houses.		
	c.	Supply and installation of Bio Digester type Sewage Treatment Unit STP for 20 persons capacity for CW/ RW pump house each.		
F.	Stoplogs, Trashracks and Lifting Beams for Cooling Water (CW) Package (Hydro Mechanical portion):			
	The scope of works covers the design, preparation of detailed fabrication drawings, supply, manufacture, transportation, insurance, erection, shop and site painting, testing and commissioning of the Hydro Mechanical equipment mentioned below;			
	a)	Two (2) sets of Slide type Stoplogs for clear opening of size 5600 mm (width) x 8650 mm (height) comprising three (3) interchangeable units and one (1) top unit consisting		

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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS				
	of skin plate, vertical stiffeners, horizontal girders, end vertical girders, mild steel slide block base, bronze slide pad, seal assembly, guide shoes, lifting lugs and filling valve in the top unit of stoplog for achieving balanced head condition and its accessories. b) Five (5) sets of embedded parts for Stoplogs consisting of stainless-steel sliding tracks with mild steel bases, guide tracks, stainless steel seal seats, sill beams 1st and 2nd stage anchor bolts with nuts etc. c) Five (5) sets of dogging beam with embedments at top of pier to support the stoplog unit when not in use or during maintenance. d) One (1) No. semi-automatic lifting beam for operating Stoplog units with counterweight system for engaging / disengaging with front and side guides. e) Six (6) sets of Trashracks for five (5) openings each of size 5600 mm (width) x 9500 mm (height) in 5 units each with grill size of 100 mm x 100 mm. f) Five (5) sets of embedded parts for Trashracks consisting of stainless-steel sliding tracks with mild steel bases, guide tracks, sill beams 1st and 2nd stage anchor bolts with nuts etc. g) One (1) No. semi-automatic lifting beam for operating Trashrack panels with counterweight system for engaging / disengaging with front and side guides. Note: i. The Stoplogs and Trash racks shall be operated by 5 MT Capacity and 2 MT Capacity monorail hoist respectively. However, the hoists are not envisaged to be under the scope of this contract but requisite arrangements to connect the lifting beam with the hook of the monorail shall be provided. ii. Clear opening has been indicated for the Stoplog. However, the height of the Stoplog to be provided shall be from the sill level of the sump house to the bottom of the breast wall in the sump house which is to be finalized based on the pump characteristics. E. Cooling Water Pipes for Cooling Water (CW) Package (Hydro Mechanical portion): The scope of works in this contract mainly covers preparation of detailed fabrication drawings based on tender specifications & tender drawings, supply, manufacture, transportation, insurance, erection, shop and site painting, testing and commissioning of CW steel pipes for cooling water from CW pump house to terminal point at Transformer yard and from terminal point to the Cooling Towers (IDCTs). The scope also includes welding, alignment of specials like bends, reducers, diffusers, branch connection like tees, laterals, supply and erection of dish ends for CW pipes by cold pressing of plates, flanges, manholes, rung ladders, connection/fixing/erection of stubs for ARV and metallic parts/equipment/valves(all type and size). Hydro-testing of CW Pipes are to be carried out as per the specifications. The pipes below ground are required to be embedded in concrete (RCC/PCC).				
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS 			
F.	Stoplogs, Trashracks and Lifting Beams for Raw Water (RW) Package (Hydro Mechanical portion): The scope of works covers the design, preparation of detailed fabrication drawings, supply, manufacture, transportation, insurance, erection, shop and site painting, testing and commissioning of the Hydro Mechanical equipment mentioned below; - Two (2) sets of Slide type Stoplogs for clear opening of size 1600 mm (width) x 2000 mm (height) comprising one (1) bottom unit and one (1) top unit consisting of skin plate, vertical stiffeners, horizontal girders, end vertical girders, mild steel slide block base, bronze slide pad seal assembly, guide shoes, lifting lugs and filling valve in the top unit of stoplog for achieving balanced head condition and its accessories. - Five (5) sets of embedded parts for Stoplogs consisting of stainless-steel sliding tracks with mild steel bases, guide tracks, stainless steel seal seats, sill beams 1st and 2nd stage anchor bolts with nuts etc. - Five (5) sets of dogging beam with embedments at top of pier to support the stoplog unit when not in use or during maintenance. - One (1) No. semi-automatic lifting beam for operating Stoplog units with counterweight system for engaging / disengaging with front and side guides. - Six (6) sets of Trashracks for five (5) openings each of size 1600 mm (width) x 10500 mm (height) in 5 units each with grill size of 100 mm x 100 mm. - Five (5) sets of embedded parts for Trashracks consisting of stainless-steel sliding tracks with mild steel bases, guide tracks, sill beams 1st and 2nd stage anchor bolts with nuts etc. - One (1) No. semi-automatic lifting beam for operating Trashrack panels with counterweight system for engaging / disengaging with front and side guides. Note: - The Stoplogs and Trashracks shall be operated by 5 MT Capacity and 2 MT Capacity monorail hoist respectively. However, the hoists are not envisaged to be under the scope of this contract but requisite arrangements to connect the lifting beam with the hook of the monorail shall be provided.			
G.	Raw Water Pipes for Raw Water (RW) Package (Hydro Mechanical portion): The scope of works in this contract mainly covers preparation of detailed fabrication drawings based on tender specifications & tender drawings, supply, manufacture, transportation, insurance, erection, shop and site painting, testing and commissioning of steel pipes for Raw water from terminal point near the Raw water reservoir to RW pump house. The scope also includes welding, alignment of specials like bends, reducers, diffusers, branch connection like tees, laterals, supply and erection of dish ends for RW pipes by cold pressing of plates, flanges, manholes, rung ladders, connection/fixing/erection of stubs for ARV and metallic parts/equipment/valves(all type and size). Hydro-testing of RW Pipes are to be carried out as per the specifications. The pipes below ground are required to be embedded in concrete (RCC/PCC).			
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
3.02.00	The scope of work as specified above shall not be considered as comprehensive. They are provided herein to enable the bidders to access the nature of the work involved. Bidders are advised to visit site and to assess the prevailing condition at site. The actual scope shall be based on the drawings issued to the contractor at the execution period only for the above broad scope of work. The work shall generally involve excavation and filling, shoring/ sheet piling, strutting, cast-in-situ concrete works, reinforcement, formwork and staging, embedded parts (including laying of rails and anchor fasteners), grouting, joints in concrete, dismantling, chipping and making an opening in P.C.C./ R.C.C., pre-cast cement concrete works, structural steel fabrication and erection including CW liners/ pipes, masonry and allied works, sheeting and allied works, floor finishing, doors, windows and partitions, glass and glazing, water proofing, false ceiling, fencing and gates, water supply drainage and sanitation, earthing mat, aluminium composite panel etc. all complete.			
3.3.1	The Works to be performed under this Specification shall also include: a) Preparation of scheme for excavation and dewatering, bar bending schedule, staging drawings, fabrication drawings, cutting plans, grating drawings, sheeting drawings, working drawings for finishes (e.g. flooring/ floor pattern, doors, windows, ventilators, louvers, cladding, false ceiling, roofing, toilet block, pantry block, glass and glazing including curtain glazing, sewerage, rain water down comers, partitions, gates, rolling shutters, sliding shutters etc.) and obtaining the approval of the Engineer. This shall also include preparation of data sheet for all bought out items and obtaining the approval of the same from Engineer. b) Execution of the works according to released for construction drawings issued by Owner and fabrication drawings/ working drawings/ scheme drawings, etc. prepared by the contractor and approved by the Engineer, procurement of all bought out items as per approved data sheet, including providing all labour, supervision, materials, consumables, scaffolding, fuel, construction equipment, tools and plants, supplies, transportation, all sampling, testing and quality assurance, providing necessary facilities and equipment to Engineer for carrying out the inspection and quality check, setting out layout and levels, safety measures conforming the general environmental requirements, carrying out construction and erection in a mechanized manner, storage, repair/ rectification/ maintenance until handing over, furnishing of design, working drawings, calculations, data sheets, records, etc. complying with statutory provisions and applicable laws etc. c) Covering all contingencies, overheads, levies, taxes, royalties, duties etc. d) Covering all incidental items not specifically mentioned but reasonably implied and necessary for successful completion of the work. e) Providing supervision by specialist agencies, wherever required.			
3.04.00	All work shall be performed in accordance with drawings released by the Engineer, Technical Specifications, Schedule of Quantities, General Conditions of Contract, Special Conditions of Contract, and directions of the Engineer. Item/ items of work			
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
	though specified in the Schedule of Quantities but for which detailed specifications are not given in the technical specifications, shall be performed as per the best available industry practice.			
3.05.00	In case of conflict between the stipulations contained in various sections of these specification and stipulations of Indian standards, codes etc. the more stringent requirements of the two stipulations shall prevail.			
4.00.00	CONTRACTOR'S OBLIGATIONS The bidder/ contractor shall be deemed to have full knowledge of the site and site limitations, whether he visits site or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed.			
4.1.1	Site Visit			
4.1.2	Before tendering, bidder is advised to visit site and its surroundings to assess and satisfy themselves about the local conditions such as access roads to the site, approach road available within project site, adequacy of the existing culverts/ bridges/ roads for the expected traffic, water and power supply, application/ details of taxes, duties, royalties and levies, nature of ground and subsoil condition, underground water table, availability of accommodation, weather characteristics, local terrain, availability of construction materials, minimum wages, labour and other related laws, environmental and safety laws, acts and regulations and any other relevant information, as required by them. The bidder may obtain all necessary information as to risk, contingencies and other circumstances, which may influence or affect their tender. Bidder shall be deemed to have considered local conditions and information and to have satisfied himself in all respects before quoting his rates and terms and no claim whatsoever in this regard shall be entertained by the Owner at a later date.			
4.2.1	Site Limitations			
4.2.2	a) A close look at the general layout plan enclosed with the tender documents indicates that there will be limitations of space during the construction stage. Simultaneously, many other civil, mechanical, electrical, C&I contractors are required to work in the area, where the successful bidder for this work will also have to work. The contractor for the work has to plan and co-ordinate to meet the requirements of other contractor's and re-organise/ re-schedule his work activities, if required. Rescheduling from time to time may be done after ascertaining the progress achieved. b) The bidder's unit rates shall be inclusive of all such contingencies and no payments whatsoever in this regard (any compensation for working under difficult circumstances or for rescheduling of the work) shall be entertained by the Owner, at a later date.			
4.2.3	Contractor shall make all necessary arrangements, whatsoever required including all weather truckable/ haulage roads, for transportation of: i) Concrete from batching plant to the place of construction.			
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4.2.3	ii)	Assembled/ fabricated structures from fabrication/pre-assembly yard to the erection site.			
	iii)	Construction materials.			
	vi)	Materials/ Earth to disposal area.			
	The contractor shall make his own arrangement for approach (access road) to work site including disposal area and for movement of men, machinery and other equipment. The access road near to the work site and drainage may not be available at the time of mobilisation. The contractor shall plan his work within the plant area considering roads and drains in the plant area are not available. All drainage of work areas including fabrication yard and all weather truckable/ haulage roads/ access road to facilitate the movement of man, material and heavy equipment like cranes, tractor trailer, transit mixer, dumpers, water tanker etc., what so ever are required by the contractor shall be constructed and maintained by the contractor.				
	The general layout plan enclosed with the tender, shows the area earmarked for various buildings and facilities including power house building, CW pump house, cooling towers, roads etc. The drains to be constructed by the owner shall be the ones lying along the roads shown in general layout plan. Cross drains, whatsoever required to drain out the water from the fabrication yard and any other working areas to avoid the water logging, shall be constructed by the contractor.				
	Hard crusting for fabrication/pre-assembly yard, if required, shall be carried out by the contractor. Other development of the fabrication yard like fabrication bed, power distribution points, cable laying, drains etc., shall be done by the contractor at his own cost.				
	Contractor's Office & Store Buildings				
	For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Portacabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look.				
4.2.7	Use of Ash and Ash based Products				
	In line with Gazette Notification on Ash Utilisation issued by MOEF and its amendment thereafter, contractor shall use ash and ash-based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash-based products in construction of his offices, stores, quarters for staff and labour etc. He shall furnish a compliance report along with all details of use of ash and ash-based products along with each bill.				
4.2.8	Repair & Maintenance Facilities by the Contractor				
	Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements/tie up with equipment manufacturers / suppliers for periodic				
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		overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.		
4.3.1		Working Hours		
4.3.2		The contractor shall normally work in two shifts every day. Erection work, however, shall be done during the day shifts only, as far as possible. The contractor shall, however, intimate the engineer well in advance in case he desires to carryout the work in the third shift also. The contractor shall provide adequate illumination during the night shift.		
5.00.00		SPECIAL INSTRUCTIONS TO BIDDERS		
5.01.00		All structures for CW Pump House and Raw Water Pump house (except CW/RW Liners/Pipes) shall be fabricated in factory, checked by pre-assembly, transported to project site and shall have bolted field connections. CW/RW Liners/Pipes can however be fabricated at site.		
5.2.1		Deleted		
5.2.2		Deleted		
5.2.3		Deleted		
5.2.4		Deleted		
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6.00.00	CODES AND STANDARDS	
6.01.00	All applicable standards, specification etc., and codes of practice shall generally be the latest editions, including all applicable official amendments and revisions issued upto thirty (30) days prior to the date of opening of this tender. A complete set of all these documents shall generally be available at site, with the contractor and shall be made available to Engineer whenever he desires.	
7.00.00	DRAWINGS AND DOCUMENTS	
7.1.1	General	
7.1.2	All drawings and documents shall be submitted in `quadruplet', unless noted otherwise, along with one soft copy. One copy of the `drawings and document' duly stamped shall be returned to contractor. All drawings and documents shall generally be stamped for Cat. – IV, i.e., for information purpose only, unless noted otherwise. After receiving the stamped drawings, the contractor shall further make copies and furnish the requisite number of copies, as desired by Engineer, of these drawings and document, along with one soft copy.	
7.1.3	Approval whatsoever by the Engineer, shall not relieve the contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship etc. of his design/ drawings.	
7.1.4	All fabrication drawings, bar bending schedules, cutting plans, staging drawings and other working drawings shall be prepared by contractor on AutoCAD. For preparing such drawings at site, contractor shall keep a dedicated field engineering team,	

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7.01.04	comprising of well-experienced engineer, architect and AutoCAD operator, as a part of his site establishment. All documents other than working drawings submitted by the contractor to the engineer shall be prepared in MS office.			
7.2.1	The data sheet for bought out items shall include technical parameters as mentioned in the Technical Specification and/or in the relevant codes/ standards along with their reference and the applicable tolerance limit. The working/ fabrication drawings shall include all details required for construction along with the applicable construction schedule and the bill of material including all fittings/ fixtures/ hardware etc. The contractor shall submit the working/ fabrication drawings related to following work/ activities to Engineer. The list is indicative only (not exhaustive) and drawings for any other work/ activities as directly by Engineer shall also be submitted. i) Scheme for excavation, sheet piling (if required) and dewatering. ii) Concrete Outline Drgs. iii) Bar bending schedule for reinforcement. iv) Pipe embedments (Pipe & Bends fabrication Drawings) v) Fabrication drawings including cutting plans for structural steel vi) Fabrication drawings including cutting plans for CW/RW Liners/Pipes, specials, bends etc. vii) Electro forged gratings. viii) Sheeting and allied works. ix) Floor finishes. x) Door windows and partitions. xi) Glass and glazing. xii) Water proofing treatment. xiii) False ceiling. xiv) Gates. xv) Toilet and pantry block. xvi) Water supply and drainage. xvii) Rain Water down comer pipes - xviii) Data sheet for all bought out items			
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7.3.1	The Contractor shall submit back-up design calculations and documents as listed below and/ or as required by Engineer. The list is indicative only (not exhaustive) and any other calculations and documents required by the Engineer shall also be submitted. i) Liner/Pipe profile calculation for Liner/Pipe fabrication drawings including dish end. ii) Joint calculations for fabrication drawings. iii) Formwork/ staging for foundations. iv) `I' and `Z' values along with deflection calculations for sheeting and allied works. v) Drawing wise quantities for all major items vi) Painting scheme of steel structures.			
7.4.1	The Contractor shall submit the following records of construction. The list is indicative only (not exhaustive) and any other record required by the Engineer shall also be submitted. i) As built construction/ working drawings ii) As built fabrication drawings. iii) All records for concreting and reinforcement as indicated under Section - 2 of this document. iv) Sampling, testing and quality records. v) Ground levels. vi) Data sheet for procurement of bought out items.			
9.00.00	LAYOUT AND LEVELS			
9.01.00	The layout and levels of all structures, etc. shall be made by the contractor from the general grid of the plot and benchmarks given by the Engineer and under no circumstances shall the contractor remove or disturb any permanent marks without approval of the Engineer. The contractor shall make his own surveying arrangements for locating the co-ordinates and positions of all works and establishing the reduced levels (RL's) at these locations based on two reference grid lines and one bench mark as furnished by the Engineer. The theodolite and levelling instrument to be used by the contractor shall be of digital type (total station). The contractor shall also give all help in the form of instruments, materials and men including qualified surveyor to the Engineer, for checking the detailed layout and levels. The contractor shall be solely responsible for correctness of layout and levels.			
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9.02.00	Ground levels shall be recorded, at the grid of 10m x 10m, before taking over the site / starting of the work and at the time of handing over site to the Engineer. Wherever the levels recorded are different from these indicated in the general layout plan and or construction drawing, same shall be brought to the knowledge of Engineer.			
10.00.00	SAFETY MEASURES			
10.1.1	General			
	i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act", 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable. ii) The Contractor shall follow Owner's Safety Rules as issued from time to time with respect to safety in construction & erection. iii) The contractor shall have the approved Safety, Health and Environment (SHE), Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge. iv) The contractor shall prepare the safety plan comprising of methods to implement the Safety Policy / Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents and submit to Engineer in charge for approval as per the format of Safety plan as annexed at Annexure-I. v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the site. vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards to not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard. vii) The Contractor shall provide suitable latest Personal Protective Equipments of prescribed standard to all his employees and workmen according to the need. The Engineer in charge shall have the right to examine these safety equipments to determine their ability, reliability, acceptability and adaptability. The contractor should also ensure availability of these before their use at worksite. viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs			
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	and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. the material shall be good and the contractor shall use standard quality of material. ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of Owner and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of Owner's safety documents as stated above. x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured. The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998. Their health records shall be maintained accordingly and to be submitted to Engineer when asked for. If any worker is found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer. The medical fitness certificate to be submitted to Engineer. xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen and office bearers working at site. a) Emergency Action Plan The contractor shall prepare and emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies. b) Scaffolding The Contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding is designed by a competent person and its erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.			
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	c)Opening The contractor shall ensure that there is no opening in any working platform / any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform / any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform shall be taken by providing suitable safety nets, safety belts or other similar means. d)Explosives The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals should be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884 are complied with.				
10.02.00	Fencing of Machinery The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery. The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine when the machinery is in motion, which may cause injury to the person.				
10.03.00	Carrying of Excessive Weight by a Worker The worker shall not be allowed to lift by hand or carry over his head, back or shoulder weight/ load more than the maximum limit set by the prescribed rules for the person.				
10.04.00	Dangerous and Harmful Gases / Equipment The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.				
10.05.00	Overhead Protection The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.				
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10.06.00	Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards. Working at Heights All working platforms, ways and other places of construction work shall be free from accumulation of debris or any other material causing obstructions and tripping. Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets, etc. and manned with trained personnel at the site of such work. Every opening at elevation from ground level through which a building worker, material equipment etc. may fall at a construction work shall be covered and / or guarded suitably by the contractor to prevent such falls. Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment of construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards. The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing / getting down through ladders to prevent fall from height.			
10.07.00	Handling of Hazardous Chemicals The contractor will notify well in advance to the Engineer of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. Owner shall have the right to prescribe the conditions under which such container is to be stored, handles and used during, the performance of the works and the Contractor shall strictly adhere to and comply with such instructions. The Engineer shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by owner and owner shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed. Further, any such decision of the Engineer shall not, in any way, absolve the Contractor of his responsibilities. In case, use of such a container or entry thereof into the Site area is forbidden by owner, the Contractor shall use alternative			
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10.08.00	methods with the approval of the owner without any cost implication to the owner to extension of work schedule. Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying out such provisions and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer. In case any approvals are necessary from the chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same. The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre / Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. The Contractor would take all precautionary measures stipulated by BARC/DAE in connection with use for storage and handling of such material. The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids. As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals. Eye Protection The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operation like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.				
	Excavation				
	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half metre above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.				
	Electrical Hazards				
10.09.00	The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules. The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live				
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	electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks. The contractor should ensure use of single / double insulated hand tools or low voltage i.e. 110 volts hand tools. The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.			
10.10.00	Vehicular Traffic The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.			
10.11.00	Lifting Appliances, Tools & Tackles, Lifting Gear and Pressure Plant and Equipment etc. The contractor shall ensure all the lifting appliances, tools and tackles including cranes, etc. lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only those certified fit for use shall be used at site. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer or by the person authorized by him.			
10.12.00	Excessive Noise, Vibration The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.			
10.13.1	Electrical Installations The contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the engineer to handle such fuses, wiring or electrical equipment. i) Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the owner he shall a) Satisfy the Engineer in charge that the appliance is in good working condition; b) Inform the Engineer in charge of the maximum current rating, voltage and phases of the appliances; c) Obtain permission of the Engineer in charge detailing the sockets to which the appliances may be connected.			
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10.16.1	In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer, Owner's Safety Officer with a copy to Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws. Right to Stop Work i) The Engineer in charge shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The contractor after stopping the specific work can, if felt necessary, appeal against the order of stoppage of work to the Engineer within 3 days of such stoppage of work and decision of the Engineer in this respect shall be conclusive and binding on the Contractor. ii) The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause 10.17.00 (i)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.						
10.17.00	Fire Protection The contractor shall provide sufficient fire extinguishers at place(s) of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the first extinguishers / equipment.						
10.18.1	Penalties i) If the Contractor fails in providing safe working environment as per the Safety Rules of owner or continues the work even after being instructed to stop the work by the engineer as provided in Clause 10.17.00 (i) above, the Contractor shall be penalised at the rate of Rs.25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer. However, in case of accident, the provisions contained in Sub-Clause 10.19.00(ii) below shall also apply in addition to the penalties mentioned in this sub-clause. ii) If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or owner's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to owner as per the following schedule : <table><tr><td>a)</td><td>Fatal injury of accident causing death</td><td>Penalty @10% of contract value or Rs.5,00,000/- per</td></tr></table>				a)	Fatal injury of accident causing death	Penalty @10% of contract value or Rs.5,00,000/- per
a)	Fatal injury of accident causing death	Penalty @10% of contract value or Rs.5,00,000/- per					
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	person, whichever is less. b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees. Penalty @ 2.5% of contract value or Rs.1,00,000/- per person whichever is less. Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time. iii) If any contractor's worker is found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer / Safety Officer of owner shall have the right to penalise the contractor for Rs.200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer / Safety Officer of owner will also issue a notice in this regard to the contractor. iv) If two or more fatal accidents occur at same owner site under the control of contractor during the period of contract and he has - not complied with keeping adequate PPEs in stock - defaulted in providing PPEs to his workmen - not followed statutory requirements / Owner's safety rules. - been issued warning notice/s by head of the project on non- observance of safety norms. - not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in THDC for two years from the date of last accident.				
10.19.00	The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by owner. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Project-wise along with the bid documents. This will also be considered for evaluation of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.				
10.20.00	Award				
	If the contractor's performance on safety front is found satisfactory i.e. without any fatal / reportable accident in the year of consideration; he may be considered for				
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10.21.00	suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.			
	Some of the relevant safety codes are given hereunder: (latest Edition)			
	IS : 3696 (Parts 1 & 2)	Safety code for scaffolding and ladders.		
	IS : 3764	Excavation work – code of safety.		
	IS : 4081	Safety code for blasting and related drilling operations.		
	IS : 4130	Demolition of buildings – code of safety.		
	IS : 5121	Safety code for piling and other deep foundations.		
	IS : 5916	Safety code for construction involving use of hot bituminous materials.		
	IS : 7205	Safety code for erection of structural steel work.		
	IS : 7293	Safety code for working with construction machinery.		
IS : 7969	Safety code for handling and storage of building materials.			
Indian Explosives Act 1940	As updated			
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	Annexure – I			
	Safety Plan			
	1. Safety Policy of the Contractor to be enclosed. 2. When was the Safety Policy last reviewed. 3. Details of implementation procedure / methods to implement Safety Policy / Safety Rules. 4. Name, Qualification, experience of Safety Officer. 5. Review of Accidents Analysis Method, Methods to ensure Safety and Health. 6. Unit executive responsible to ensure Safety at various levels in work area. 7. List of employees trained in safety employed before execution of the job. Give the details of training. 8. Safety Training Targets, Schedules, methods Adopting to providing safety training to all employees. 9. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed). 10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed. 11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity. 12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up. 13. Provision for treatment of injured persons at work site. 14. Review of overall safety by top Management and Periodicity. 15. System for Implementation of Statutory legislations. 16. Issue of PPEs to employees, Periodicity / stock on hand etc.			
	Signature Head of the Organisation with date & stamp			
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	The contractor shall execute all work at site as per the general environmental requirement and following the applicable codal provisions and local regulations in this respect. The contractor shall provide and install suitable safeguards and facilities as approved by the Engineer for meeting general environment requirements given herein under.			
13.01.00	Protect from damage and disturbance of the existing trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipe lines, drains, sewers, or other surface or sub-surface systems/ facilities within or adjacent to the works being carried out.			
13.02.00	Take all necessary precautions against soil erosion, water and environmental pollution and safe disposal of waste material.			
13.03.00	Control the ground in the vicinity of all excavations, so that the surface of the ground is properly sloped or dyked to prevent surface water from running into the excavated areas, during construction.			
13.04.00	All materials obtained from excavation shall remain Owner's property. All salvaged materials of archaeological importance or of value (in the opinion of the Engineer) shall be segregated from the other materials and stacked separately at locations as indicated by the Engineer.			
13.05.00	The method and arrangement of blast cleaning shall conform to factory act, local laws, stipulations of pollution control board, if any.			
13.6.1	a) Excavated earth should be stockpiled properly at designated areas so as not to spread and cause air pollution (fugitive dust emission) and water pollution (suspended solids in run-off). Top soil (top 150mm layer of the fertile soil) may be stored separately for future use in landscaping/ re-vegetation/ horticulture. b) Solid wastes generated during construction such as construction debris, excess cement/ concrete, wrapping materials (e.g. plastic packets and wrappers), timber, tins, cans and drums, wire, nails, glass etc., chemical wastes and hazardous wastes, food and domestic wastes etc., should be properly disposed off so as not to cause any air/ water pollution. c) Potential pollutants (such as oils, chemicals) shall be kept, stored, and used in such a manner that any escape can be contained and the surface and ground water resources are not contaminated. d) Water containing pollutants such as cements, concrete, lime, chemicals and oils shall be discharged through a temporary sedimentation and equalisation tank. e) The necessary precautions shall be taken to control emission of fugitive dust and suspended solids in effluents leading to sedimentation of receiving water bodies. f) Provide necessary sanitation facilities to the labour camps.			
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14.1.10	Fabrication and erection of all structural steel works shall be done with the help of cranes only. Use of derricks shall not be permitted. Gantry cranes/ truck mounted/ cranes/ crawler cranes shall be used in fabrication yard. Heavy crane having lifting capacity and boom length matching with the heaviest part to be lifted shall be used for the erection work, in combinations of other cranes. For erection of heavy members simultaneous use of two cranes may be required. Part columns and roof beam shall be erected in single piece, unless specified otherwise. Contractor's specific attention is invited to the erection scheme given in the 'fabrication and erection of structural steel works' under Part `B' of this specification.	
14.1.11	Blast cleaning of the steel surfaces shall be done in a suitable enclosure, so as not to cause any damage/ pollution to the adjoining areas. Painting shall be done using airless spray guns. Handling of the structures shall be done in a mechanised way.	
14.1.12	Modular units of scaffolding and shuttering shall be used.	
14.1.13	Grouting shall be carried out using hydraulically controlled grouting equipment.	
14.1.14	All finishing items including roofing/ cladding/ sheeting etc., shall be installed/ fixed in position, using appropriate modern mechanical tools and deploying expert technicians. Manual punching, etc shall not be permitted.	
14.1.15	Electrical power winches, electrically operated heavy duty hoists and tyre mounted mobile tower crane, for lifting of construction materials shall be deployed.	
14.1.16	Cleaning of foundations and other surfaces shall be done by compressed air using heavy duty compressors.	
14.1.17	Stone/ tile/ marble/ granite cutting and polishing machines shall be deployed for flooring works.	
14.1.18	Breaking of concrete, wherever required, shall be done by using jack hammers.	
14.1.19	Field laboratory shall be provided with all latest equipment for survey, testing of soil, aggregates, concrete, etc. For testing of structural steel works, ultrasonic testing machines, radiographic testing machines, dye penetration test equipment, etc, shall be deployed. Help of specialist agencies shall be taken for ultra sonic/ radiographic and other specialised testing.	
14.1.20	Other materials like cables, slings, heating ovens, pre-heating arrangement, materials for making platforms and platform supports etc., shall be mobilised as per the requirement.	
14.1.21	All persons working at site shall be provided with necessary safety equipment such as gloves, goggles, safety belts, safety helmets etc.	
14.1.22	All safety aspects shall be duly considered for each construction/ erection activity.	
14.1.23	Only the persons who are trained in the respective trade shall be employed for executing that particular type of work.	
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE Bid Doc. No.: THDC/RKSH/CC- 9915-414 TECHNICAL SPECIFICATIONS PART-A Page 28 of 88		

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
14.1.24	Construction of pump house sub-structure foundations and other main foundations shall be done after the approval of the scheme for staging and concreting.			
14.1.25	All layouts and levels shall be taken using digitised theodolite and level, i.e., Total workstation.			
14.1.26	For deep excavations, sheeting, shoring, bracing, and maintaining suitable slopes etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
14.1.27	Concrete core cutting machine and concrete sawing machine shall be used respectively for making circular and slit type opening in the concrete. Rebar/ detector shall be used to identify the location of reinforcement, before making opening in the concrete.			
14.1.28	The contractor shall mobilise all plant equipment/ machinery required for successful completion of the work. A list of the plant equipment/ machinery required to be deployed by the bidder to match with the agreed work schedule and the construction and erection methodology is appended as Appendix - II to this document. This list, however, is not an exhaustive list but specifies the minimum requirements of equipment and machinery to be deployed for the execution. Any additional equipment and machinery required for the timely completion of the works but not listed in the Appendix - II shall also be deployed by the contractor, as directed by the Engineer.			
15.00.00	SAMPLING, TESTING AND QUALITY ASSURANCE For Quality Assurance and Inspection for Civil works, refer Part - C of this specification.			
16.00.00	RATES AND MEASUREMENTS			
16.1.1	Rates			
16.1.2	The various items of the Schedule of Quantities shall be read in conjunction with the Technical Specification, Tender Drawings, Special Conditions of Contract, General Conditions of Contract, including amendments and additions thereon.			
16.1.3	Unit Rates for different Items of the Schedule of Quantities shall include the cost for: a) All the activities covered in the description in the Schedule of Quantities read in conjunction with the notes/ instructions/ undertaking mentioned therein, as well as for all necessary operations described in the Technical Specifications (Part - A, B & C), Special Conditions of Contract, General Conditions of Contract etc. b) The provision of the item in totality and completeness, unless some item/ items of work though required for completion of the items but are explicitly excluded from that item of work, in the Schedule of Quantities. c) Minor works, which may not have been mentioned in the description of item in the Schedule of Quantities read in conjunction with Technical Specification			
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE	Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A	Page 29 of 88

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS				
	and other bid document, but are essential for the satisfactory completion of the work. d) All works associated with site visit, site limitation and working hours etc., as mentioned under Contractor's obligation elsewhere in this part of Technical Specification. e) Preparation, submission and approval of working/ fabrication drawing, design calculations, data sheets other documents and records of construction, etc, mentioned under 'Drawings and Documents', elsewhere in this part of Technical Specification. f) All safety measures as required by codal provisions, local regulations and as specified under 'Safety Measures' elsewhere in this part of Technical Specification. g) Arranging for construction water as specified under `Construction water and Construction power' elsewhere in this part of Technical Specification. h) Providing for suitable safeguard and facilities whatsoever required to meet the general environment requirement as specified under 'General Environmental Requirement' elsewhere in this part of Technical Specification. i) All works activities, equipment, instrument, personnel, material etc. to comply with sampling and testing and quality assurance requirement including construction tolerances and acceptance criteria as given in Part - C of Technical Specification. j) Providing for construction and erection methodology/ requirement as specified elsewhere in this specification under 'Construction and Erection Methodology/ Requirements'. This shall include provision of all plant, equipment, labour, supervision, technical personnel, materials, transportation, staging, all temporary works, skilled and trained manpower whatsoever required etc., for carrying out the work in a mechanised way, right from the start of work. k) Establishing layout and levels of all structures as mentioned elsewhere in this part of the specification under 'Layout and Levels'. This shall also include the layout/ level/ coordination at each location of building, foundations, piles (if applicable), underground facilities (like drains, sewers etc.) etc. from one established bench mark and set of grid lines furnished by owner l) All subsoil conditions. m) Working out steel requirement, i.e., section wise requirement of reinforcement and structural steel. n) All working conditions including under water/ mud, extreme weather conditions etc.				
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A	Page 30 of 88

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS			
	o) Movement/ shifting of plant and machinery including piling rig (if applicable) from one location to another location as per the requirement of works and as directed by Engineer. p) The working out of quantities for major civil work Items based on the design/ construction drawings supplied by Owner and working/ fabrication drawings developed by the contractor. The bill of quantities (in proper format) shall be submitted to the Owner, along with back up calculations. q) Construction and subsequent demolition/ removal from site of all temporary and enabling works, such as site offices, construction water, construction power, temporary structures, access roads etc. r) Procurement of bought out item from approved vendor as per approved data sheet. s) Execution of work under supervision of specialised agency. t) Recording ground/ grade levels at the grid of 10m x 10m before taking over the site/ starting the work and obtaining the specific approval of the engineer wherever the level are different from the level indicated in the general layout plan. u) Recording level at the grid of 10m x 10m before handing over the site to the Engineer. v) All packing, crating, boxing, coating, covering, protecting whatsoever required to prevent damage or deterioration during transit, handling and erection, covered storage at site for all bought out items, till their use in work/ fixing in position/ installation/ erection etc.			
17.1.1	Measurements			
17.1.2	All measurements shall be done in SI units.			
17.1.3	The Contractor and the Engineer shall jointly record all Measurements			
17.1.4	Linear Measurements shall be done in Metres (M) (unless noted otherwise) and rounded off to second place of decimal. Areas and volumes shall be calculated from the linear measurements and shall generally be in Sq. Meter (Sq. M. or M ²) and Cubic Meter (Cu. M. or M ³) respectively (unless noted otherwise), rounded off to two place of decimals. For rounding off, values in the third place of decimal, which are below '5' shall be ignored and those above '5' shall be considered as 10.			
17.1.5	Weight measurement shall be done in Metric Tonne, (unless noted otherwise), rounded off to third place of decimal.			
17.1.6	For each item of work, the quantity to be considered for payment shall be lesser of the actual quantity executed and the quantity calculated on the basis of mode of measurements, given elsewhere in the technical specification.			
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A Page 31 of 88

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS				
18.00.00	BOUGHT OUT ITEMS				
18.01.00	All bought out items shall be procured on the basis of approval of samples and as per approved data sheet and working drawings.				
18.02.00	a) Metal cladding/ roofing/ decking, aluminium composite panels, curtain glazing, aluminium work, water proofing, high performance painting system for structural steel works etc., shall be from established and reputed manufacturers/ agency who have the experience of successfully supplying the work of almost same magnitude, as specified for this package. These works shall be executed by the specialist agency under the supervision of the manufacturer/agency. b) Various other bought out Items such as admixtures, PVC conduit, anchor fasteners, MS & high tensile steel bolts, electro forged gratings, finish paint, textured coating, insulation, glazing, automatic operation for door, false ceiling, floor finishes (such as tiles, granites, marbles etc.) sanitary fittings and fixtures in toilet block and pantry etc. shall be from established and reputed manufacturer.				
18.03.00	All materials shall be ordered, procured and stored well in advance to avoid use of sub standard items under compulsion to maintain the construction schedule.				
18.04.00	All materials shall be accompanied with relevant test certificates establishing the quality and genuineness of materials being supplied.				
18.05.00	All bought out items shall be from the approved vendors. For this purpose contractor shall submit the list of vendors for each of the above mentioned items and finalize the same with the Owner within one month of the award of work.				
18.06.00	The bought out items identified above are indicative only and not exhaustive. The contractor shall get the vendor approval for any other items, if so directed by the Engineer.				
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A	Page 32 of 88

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS																																																																			
	APPENDIX – II LIST OF SUGGESTED PLANTS, EQUIPMENT AND MACHINERY REQUIRED TO BE DEPLOYED BY CONTRACTOR AT SITE In order to ensure timely completion of the work, in accordance with the schedule indicated in the bar chart, the Bidder should mobilise the following minimum equipment in case of award: <table><tr><th>Sl.No.</th><th>Description</th><th>Quantity</th></tr><tr><td>1.</td><td>Concrete batching plant (minimum 40 cum/hr capacity)</td><td>2</td></tr><tr><td>2.</td><td>Concrete pumps</td><td>6</td></tr><tr><td>3.</td><td>Bull Dozer (Heavy Duty)</td><td>5</td></tr><tr><td>4.</td><td>Poclain (Shovel) (minimum 1 cum capacity each)</td><td>4</td></tr><tr><td>5.</td><td>Dumpers</td><td>24</td></tr><tr><td>6.</td><td>Trucks</td><td>2</td></tr><tr><td>7.</td><td>Rollers (10T capacity)</td><td>1</td></tr><tr><td>8.</td><td>Sheep Foot roller</td><td>1</td></tr><tr><td>9.</td><td>Vibro Compactor/ Roller</td><td>2</td></tr><tr><td>10.</td><td>Water Tankers</td><td>2</td></tr><tr><td>11.</td><td>Diesel Power Generator – 60 KVA capacity</td><td>2</td></tr><tr><td>12.</td><td>Diesel Power Generator – 5 KVA capacity</td><td>1</td></tr><tr><td>13.</td><td>Survey equipment: Total Station</td><td>2</td></tr><tr><td>14.</td><td>Lab equipment for testing of soil, concrete etc.</td><td>As per requirement</td></tr><tr><td>15.</td><td>Vibrators Needle type</td><td>18</td></tr><tr><td>16.</td><td>Vibrator (Float, Plate etc.)</td><td>4</td></tr><tr><td>17.</td><td>Dewater pumps</td><td></td></tr><tr><td></td><td> i) 5 HP</td><td>6</td></tr><tr><td></td><td> ii) 10 HP to 50 HP</td><td>6</td></tr><tr><td>18.</td><td>Service compressor with hose</td><td>6</td></tr><tr><td>19.</td><td>Jack Hammers</td><td>4</td></tr></table>		Sl.No.	Description	Quantity	1.	Concrete batching plant (minimum 40 cum/hr capacity)	2	2.	Concrete pumps	6	3.	Bull Dozer (Heavy Duty)	5	4.	Poclain (Shovel) (minimum 1 cum capacity each)	4	5.	Dumpers	24	6.	Trucks	2	7.	Rollers (10T capacity)	1	8.	Sheep Foot roller	1	9.	Vibro Compactor/ Roller	2	10.	Water Tankers	2	11.	Diesel Power Generator – 60 KVA capacity	2	12.	Diesel Power Generator – 5 KVA capacity	1	13.	Survey equipment: Total Station	2	14.	Lab equipment for testing of soil, concrete etc.	As per requirement	15.	Vibrators Needle type	18	16.	Vibrator (Float, Plate etc.)	4	17.	Dewater pumps			i) 5 HP	6		ii) 10 HP to 50 HP	6	18.	Service compressor with hose	6	19.	Jack Hammers	4
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KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE	Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS																																																																		
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CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS				
	Sl. No.	Description	Quantity		
	20.	Heavy capacity trailer with drive units for material shifting (10 - 15 T capacity)	3		
	21.	Transit mixers	8		
	22.	Plate bending machine			
		i) 25 x 2500mm	2		
		ii) 20 x 2500mm	2		
	23.	Plate straightening machine			
		i) 20 x 2500mm	2		
	24.	Automatic submerged arc welding machine M/C	5		
	25.	Semi automatic submerged arc welding machine	6		
	26.	Welding transformer	12		
	27.	Welding generator	8		
	28.	Pug cutting machine	4		
	29.	Radiographic testing machine	4		
	30.	Bench grinder	2		
	31.	Hand grinder	8		
	32.	Shuttering material	5000 m ²		
	33.	Chipping hammers	6		
	34.	Scaffolding pipes	5000		
	35.	Mobile Crane (Min. 10 T capacity)	3		
	36.	Portable drilling machine	5		
	37.	Concrete Mixer	2		
	38.	Electric Winch / Manual Winch	9		
	39.	Chain Pulley block	5		
	40.	60 mm Nozzles for vibrators	25		
	41.	Mechanical Excavator of 0.9 Cu.M capacity	2		
	42.	Loaders	1		
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A	Page 35 of 88

CLAUSE NO.	SCOPE AND SPECIAL TECHNICAL REQUIREMENTS																																				
	<table><thead><tr><th>Sl.No.</th><th>Description</th><th>Quantity</th></tr></thead><tbody><tr><td>43.</td><td>Plate vibrator</td><td>2</td></tr><tr><td>44.</td><td>Grab of 0.75 cubic yard capacity with adequate spares</td><td>1</td></tr><tr><td>45.</td><td>Air compressor of 250 cfm capacity</td><td>1</td></tr><tr><td>46.</td><td>Chisel</td><td>1</td></tr><tr><td>47.</td><td>Hydra type crane</td><td>2</td></tr><tr><td>48.</td><td>Gas cutting sets</td><td>10</td></tr><tr><td>49.</td><td>Any other major equipment proposed to be used for the satisfactory completion of the work</td><td>As per requirement</td></tr><tr><td>50.</td><td>Safety Net (conforming to IS 11057:1984) Net Size: 10m x 5m, Mesh size: 25mm, Mesh Rope: 2mm double cord, Border/Tie cord: 12mm diameter polypropylene rope (tested as per IS:5175), Two meters lengths shall be provided at all four corners</td><td>10 Nos.</td></tr><tr><td>51.</td><td>Safety PPEs (Industrial Safety helmets & Industrial Safety/ Electrical shoes)</td><td></td></tr><tr><td></td><td>i) Industrial Safety Helmet (IS:2925-1984 marked)</td><td>100 Nos.</td></tr><tr><td></td><td>ii) Industrial Safety/ Electrical Shoes (IS:15298-2002 marked)</td><td>100 Nos.</td></tr></tbody></table>	Sl.No.	Description	Quantity	43.	Plate vibrator	2	44.	Grab of 0.75 cubic yard capacity with adequate spares	1	45.	Air compressor of 250 cfm capacity	1	46.	Chisel	1	47.	Hydra type crane	2	48.	Gas cutting sets	10	49.	Any other major equipment proposed to be used for the satisfactory completion of the work	As per requirement	50.	Safety Net (conforming to IS 11057:1984) Net Size: 10m x 5m, Mesh size: 25mm, Mesh Rope: 2mm double cord, Border/Tie cord: 12mm diameter polypropylene rope (tested as per IS:5175), Two meters lengths shall be provided at all four corners	10 Nos.	51.	Safety PPEs (Industrial Safety helmets & Industrial Safety/ Electrical shoes)			i) Industrial Safety Helmet (IS:2925-1984 marked)	100 Nos.		ii) Industrial Safety/ Electrical Shoes (IS:15298-2002 marked)	100 Nos.
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	NOTES: a) These requirements and capacity of the equipment are indicative only and not exhaustive and deployment of the equipment, machinery and labour shall be suitably augmented to achieve the timely completion of the work as per the program and directions of the Engineer, without any additional cost to Owner. b) Other materials like cables, sling, gloves, goggles, safety belt, safety helmets, heating oven, pre-heating arrangement, material for making platform and platform support etc. shall be mobilised as per requirement. c) Other equipment though required for the timely completion of the job and but not listed above shall be deployed by the contractor, as per the job requirements and as directed by the Engineer. d) The contractor shall make suitable provisions for repairs and maintenance of the equipment mobilised and always keep them in good working conditions, as the repair facilities for such equipment are not available at the project site. e) A minimum stock of 15 days of gas and 30 days of electrode shall be maintained at the site. f) All concreting shall be carried out using centralized batching plant, transit mixers and concrete pumps.																																				
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-A	Page 36 of 88																																

Project : Geotechnical Investigation Work for STPP Khurja in UP.

CETEST

Job No : 4184

Created by : SKD

Created on : 10/09/2019

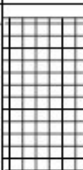
Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. DBH-63

Co-ordinates E=647
N=174

Field Test	Nos	Samples	Nos	Commencement Date :	29/08/2019
Penetrometer (SPT)	10	Undisturbed (UDS)	10	Completion Date :	30/08/2019
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter :	150 mm.
Vane (V)		Disturbed (DS)	11	Level Of Ground :	193.252 M.
		Water Sample (WS)	0	Water Struck At :	
				Standing Water Level :	6.55 m.

DESCRIPTION	SYMBOL	N-VALUE				SAMPLES	
		EACH DIVN. = 15cm				Ref. No	Depth (m)
0.00m						DS-1	0.50
Brownish grey to yellowish grey, clayey silt with traces of kankar.						UDS-1	1.00-1.45
2.50m		6	9	10	19	SPT-1	2.50-2.95
Medium dense, light grey, silty sand with clay binder.						DS-2	3.50
						UDS-2	4.00-4.45
5.50m		7	11	13	24	SPT-2	5.50-5.95
						DS-3	6.50
						*UDS-3	7.00-7.45
		6	10	17	27	SPT-3	8.50-8.95
						DS-4	9.50
						*UDS-4	10.00-10.45
		8	13	19	32	SPT-4	11.50-11.95
Medium dense to dense, light grey, sand. Observed mica.						DS-5	12.50
						*UDS-5	13.00-13.45
		10	20	24	44	SPT-5	14.50-14.95
						DS-6	15.50
						*UDS-6	16.00-16.45
		14	23	27	50	SPT-6	17.50-17.95
18.10m							

Project : Geotechnical Investigation Work for STPP Khurja in UP.						CETEST	
Job No : 4184		Created by : SKD		Created on : 10/09/2019		Sheet No:	
BORE LOG DATA SHEET			BORE HOLE NO. DBH-63			Co-ordinates E=647 N=174	
Field Test	Nos	Samples	Nos	Commencement Date : 29/08/2019			
Penetrometer (SPT)	10	Undisturbed (UDS)	10	Completion Date : 30/08/2019			
Cone (Pc)		Penetrometer (SPT)	10	Bore Hole Diameter : 150 mm.			
Vane (V)		Disturbed (DS)	11	Level Of Ground : 193.252 M.			
		Water Sample (WS)	0	Water Struck At :			
				Standing Water Level : 6.55 m.			
DESCRIPTION			SYMBOL	N-VALUE		SAMPLES	
				EACH DIVN. = 15cm		Ref. No	Depth (m)
18.10m						DS-7	18.50
						*UDS-7	19.00-19.45
				15	21	SPT-7	20.50-20.95
					46	DS-8	21.50
						*UDS-8	22.00-22.45
				17	23	SPT-8	23.50-23.95
					49	DS-9	24.50
						*UDS-9	25.00-25.45
					55		
				19	26	SPT-9	26.50-26.95
26.50m						DS-10	27.50
						*UDS-10	28.00-28.45
						DS-11	29.00
				14	28	SPT-10	30.00-30.45
30.45m					60		

Project : Geotechnical Investigation Work for STPP Khurja in UP.					CETEST					
Job No : 4184		Created by : SKD		Created on : 31/08/2019		Sheet No:				
BORE LOG DATA SHEET			BORE HOLE NO. DBH-64			Co-ordinates E=550 N=239				
Field Test	Nos	Samples	Nos	Commencement Date : 23/08/2019						
Penetrometer (SPT)	11	Undisturbed (UDS)	10	Completion Date : 24/08/2019						
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter : 150 mm.						
Vane (V)		Disturbed (DS)	10	Level Of Ground : 192.564 M.						
		Water Sample (WS)	0	Water Struck At : Standing Water Level : 6.3 m.						
DESCRIPTION			SYMBOL	N-VALUE		SAMPLES				
				EACH DIVN. = 15cm		Ref. No	Depth (m)			
0.00m				6	9	11	20	DS-1	0.50	
Medium dense, brownish grey to yellowish grey, silty sand with clay binder / clayey silty sand.								SPT-1	1.00-1.45	
								UDS-1	2.00-2.45	
								DS-2	3.00	
				7	11	14	25	SPT-2	4.00-4.45	
								UDS-2	5.00-5.45	
2.50m				8	10	13	23	SPT-3	7.00-7.45	
Medium dense to dense, light grey, silty sand. Observed mica.								*UDS-3	8.00-8.45	
								DS-4	9.00	
				6	6	12	18	SPT-4	10.00-10.45	
								*UDS-4	11.00-11.45	
								DS-5	12.00	
15.30m					5	6	8	14	SPT-5	13.00-13.45
									*UDS-5	14.00-14.45
									DS-6	15.00

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BH-64/Sheet-1

Project : Geotechnical Investigation Work for STPP Khurja in UP.								CETEST	
Job No : 4184		Created by : SKD		Created on : 31/08/2019		Sheet No:			
BORE LOG DATA SHEET				BORE HOLE NO. DBH-64		Co-ordinates E=550 N=239			
Field Test	Nos	Samples	Nos	Commencement Date :		23/08/2019			
Penetrometer (SPT)	11	Undisturbed (UDS)	10	Completion Date :		24/08/2019			
Cone (Pc)		Penetrometer (SPT)	11	Bore Hole Diameter :		150 mm.			
Vane (V)		Disturbed (DS)	10	Level Of Ground :		192.564 M.			
		Water Sample (WS)	0	Standing Water Level :		6.3 m.			
DESCRIPTION			SYMBOL	N-VALUE			SAMPLES		
				EACH DIVN. = 15cm			Ref. No	Depth (m)	
Medium dense to dense, light grey, silty sand. Observed mica.				13	19	21	40	SPT-6	16.00-16.45
								*UDS-6	17.00-17.45
								DS-7	18.00
				16	22	26	48	SPT-7	19.00-19.45
								*UDS-7	20.00-20.45
								DS-8	21.00
				Very dense, light grey, silty sand. Observed mica.				18	25
								*UDS-8	23.00-23.45
								DS-9	24.00
18	26	31	57					SPT-9	25.00-25.45
								*UDS-9	26.00-26.45
								DS-10	27.00
N.B. - '*' means sample could not be recovered.				11	22	36	58	SPT-10	28.00-28.45
								*UDS-10	29.00-29.45
				22	28	41	69	SPT-11	30.00-30.45

Project : Geotechnical Investigation Work for STPP Khurja in UP.				CETEST	
Job No : 4184		Created by : SKD		Created on : 31/08/2019	
Sheet No:		E=649		N=329	
BORE LOG DATA SHEET			BORE HOLE NO. DBH-65		Co-ordinates
Field Test	Nos	Samples	Nos	Commencement Date : 25/08/2019	
Penetrometer (SPT)	9	Undisturbed (UDS)	8	Completion Date : 27/08/2019	
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm.	
Vane (V)		Disturbed (DS)	9	Level Of Ground : 192.965 M.	
		Water Sample (WS)	0	Water Struck At :	
				Standing Water Level : 6.45 m.	
DESCRIPTION		SYMBOL	N-VALUE		SAMPLES
			EACH DIVN. = 15cm		Ref. No
					Depth (m)
0.00m					DS-1 0.50
Stiff, brownish grey to yellowish grey, clayey silt with fine sand mixture.					UDS-1 1.00-1.45
2.50m		4 6 7	13		SPT-1 2.50-2.95
					DS-2 3.50
					UDS-2 4.00-4.45
		7 11 14	25		SPT-2 5.50-5.95
					DS-3 6.50
					*UDS-3 7.00-7.45
		12 13 17	30		SPT-3 8.50-8.95
Medium dense to dense, light grey, clayey silty sand. Observed mica.					DS-4 9.50
					*UDS-4 10.00-10.45
		8 10 16	26		SPT-4 11.50-11.95
					DS-5 12.50
					*UDS-5 13.00-13.45
		13 17 19	36		SPT-5 14.50-14.95
15.30m					

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BH-65/Sheet-1

Project : Geotechnical Investigation Work for STPP Khurja in UP.

CETEST

Job No : 4184

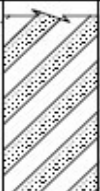
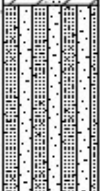
Created by : SKD

Created on : 31/08/2019

Sheet No:

BORE LOG DATA SHEET**BORE HOLE NO. DBH-65**Co-ordinates E=649
N=329

Field Test	Nos	Samples	Nos	Commencement Date : 25/08/2019
Penetrometer (SPT)	9	Undisturbed (UDS)	8	Completion Date : 27/08/2019
Cone (Pc)		Penetrometer (SPT)	9	Bore Hole Diameter : 150 mm.
Vane (V)		Disturbed (DS)	9	Level Of Ground : 192.965 M.
		Water Sample (WS)	0	Water Struck At :
				Standing Water Level : 6.45 m.

DESCRIPTION	SYMBOL	N-VALUE					SAMPLES	
		EACH DIVN. = 15cm					Ref. No	Depth (m)
Medium dense to dense, light grey, clayey silty sand. Observed mica.							DS-6	15.50
							*UDS-6	16.00-16.45
		16	20	23	43		SPT-6	17.50-17.95
							DS-7	18.50
							*UDS-7	19.00-19.45
Very dense, light grey, silty sand. Observed mica.		17	26	29	55		SPT-7	20.50-20.95
							DS-8	21.50
							*UDS-8	22.00-22.45
		18	23	28	51		SPT-8	23.50-23.95
							DS-9	24.50
		21	26	33	59		SPT-9	25.00-25.45

N.B. - '*' means sample could not be recovered.

Project : Geotechnical Investigation Work for STPP Khurja in UP.					CETEST	
Job No : 4184		Created by : SKD		Created on : 31/08/2019		Sheet No:
BORE LOG DATA SHEET			BORE HOLE NO. DBH-66		Co-ordinates $E=556$ $N=410$	
Field Test	Nos	Samples	Nos	Commencement Date : 22/08/2019		
Penetrometer (SPT)	4	Undisturbed (UDS)	4	Completion Date : 22/08/2019		
Cone (Pc)		Penetrometer (SPT)	4	Bore Hole Diameter : 150 mm.		
Vane (V)		Disturbed (DS)	4	Level Of Ground : 192.754 M.		
		Water Sample (WS)	0	Water Struck At :		
				Standing Water Level : 6.00 m.		
DESCRIPTION		SYMBOL	N-VALUE		SAMPLES	
			EACH DIVN. = 15cm		Ref. No	Depth (m)
0.00m					DS-1	0.50
Hard, brownish grey, clayey silt.					UDS-1	1.00-1.45
3.00m		7 14 17	31		SPT-1	2.50-2.95
					DS-2	3.00
					*UDS-2	4.00-4.45
Medium dense, light grey, silty sand. Observed mica.		5 9 13	22		SPT-2	5.50-5.95
					DS-3	6.00
					*UDS-3	7.00-7.45
		8 12 14	26		SPT-3	8.50-8.95
					DS-4	9.00
					*UDS-4	10.00-10.45
10.95m		8 11 16	27		SPT-4	10.50-10.95

N.B. - '*' means sample could not be recovered.

Project: Geotechnical Investigation Work for STPP Khurja in UP.



Job No. : 4184

Sheet No.

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Bore Hole	Sample Number	Depth M	Sample Description	Bulk		Dry Dens. gms/cc	Spec. Grav.	Nat. Moist. %	Void Ratio	Strength Test Results				Atter. Limits				IS			Grain Size				Test Method
				Dens. gms/cc						Po/Pn kg/sqcm	Shear kg/sqcm	Cohesion kg/sqcm	Frictn Deg.	LL %	PL %	SL %	Classf	% flsatio	Gravl %	Sand %	Silt %	Clay %			
DBH63	UDS02	4.00	Light grey, silty sand with traces of clay binder.	1.75	1.48		17 S 18DR			DISH-CU 0.5 1.0 2.0	0.404 0.689 1.408	0.07	33	24	17			SM-SC		59	38	3	Do		
DBH63	SPT03	8.50	Brownish grey, silty sand														SM-SP		90	10 (Silt+Clay)		Do			
DBH64	UDS01	2.00	Light grey clayey silty sand	1.60	1.37		15 S 17DR 17 C	0.858		DISH-CU 0.5 1.0 2.0	0.394 0.789 1.271	0.08	33	27	15	13	SC		77	19	4	Do			
DBH64	UDS02	5.00	Light grey silty sand	1.70	1.53		11 S 11DR			TRSH-CU 1.860 1.120 0.387	2.600 1.555 0.620	0.06	34												
DBH64	SPT10	28.00	Light grey silty sand with traces of mica.							DISH-CU 0.5 1.0 2.0	0.391 0.732 1.480	0.02	36	25	16		SC		62	32	6	Do			
DBH64	SPT10	28.00	Light grey silty sand with traces of mica.														SM-SP		95	05 (Silt+Clay)		Do			
DBH65	UDS01	1.00	Brownish grey clayey silt with traces of sand mixture & calcareous nodules.	1.89	1.57		20 S 20 T			TRSH-UU 3.0 2.0 1.0	1.248 1.276 1.131	0.93	5	37	24		CI		6	80	14	Do			
DBH65	UDS02	4.00	Brownish grey silty sand	1.80	1.49		21 S 21DR			UNCONFD 0.0 0.0 0.0	1.009 0.899 0.895	0.93	0												
DBH65	UDS02	4.00	Brownish grey silty sand							REMOULD 0.0 0.0 0.0	0.786 0.683 0.668	0.71	0												
DBH65	UDS02	4.00	Brownish grey silty sand	1.80	1.49					DISH-CU 0.5 1.0 2.0	0.422 0.835 1.579	0.13	34	29	17		CL-SC		80	20 (Silt+Clay)		Do			

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Project: Geotechnical Investigation Work for STPP Khurja in UP.



Job No. : 4184

Sheet No.

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Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens gms/cc	Dry Dens gms/cc	Spec. Grav.	Nat. Moist. %	Void Ratio	Strength Test Results				Atter. Limits			IS			Grain Size			Test Method	
									Pop'n kg/sqcm	Shear kg/sqcm	Cohes kg/sqcm	Frictn Deg.	LL %	PL %	SL %	Class	% flratio	Gravl %	Sand %	Silt %	Clay %		
DBH65	SPT04	11.50	Light grey clayey silty sand with traces of mica				2.67										SM			58.42 (Silt+Clay)	Do		
DBH66	UDS01	1.00	Brownish grey clayey silt with sand mixture	1.91	1.59		19 S 20 T			UNCONFD	0.99	0	32	20			CL			32	57	11	Do
										0.0	0.913												
										0.0	1.065												
										0.0	0.982												
										REMOULD	0.74	0											
										0.0	0.803												
										0.0	0.723												
										0.0	0.686												
										TRSH-CD	0.00	35											
										2.889	3.927												
										1.990	2.534												
										0.980	1.227												
DBH66	SPT02	5.50	Light grey silty sand with traces of mica														SM			81	17	2	Do
DBH66	SPT04	10.50	Light grey silty sand with traces of mica														SM-SP			89.11 (Silt+Clay)			Do
DBH67	UDS01	1.00	Whitish grey clayey sandy silt	1.69	1.51	2.68	12 S 12 T 12 C	0.661		TRSH-UU	0.89	8	25	15			CL			29	67	4	Do
										3.0	1.493												
										2.0	1.376												
										1.0	1.182												
DBH67	UDS02	4.00	Light grey silty sand	1.74	1.45		20DR			DISH-CU	0.12	31					SM			80.20 (Silt+Clay)			Do
										0.5	0.429												
										1.0	0.723												
										2.0	1.384												
DBH67	SPT04	10.50	Light grey silty sand with traces of mica				2.71										SM			85.15 (Silt+Clay)			Do
DBH68	UDS01	2.00	Brownish grey clayey silt with sand mixture	1.87	1.46		28 S			UNCONFD	0.52	0	39	22			14 CI			27	62	11	Do
										0.0	0.559												
										0.0	0.489												
										0.0	0.515												



Preliminary Geotechnical Investigation for 23660 MW Khurja Super Thermal Power Project at Khurja, Uttar Pradesh
M/s. THDC India Limited



ISO/IEC 17025:2005
Certified Laboratory
(NABL)
Certificate No. T-1741

Soil Profile (BH-20)

Location: Area-2
UTM Coordinates: 785918 E, 3118329 N

Byring Method: Shell & Auger
Casing Depth: 30.0 m
Byring Start: 11-Jan-18
Byring Finish: 12-Jan-18

Termination Depth: 30.45 m
Ground Water Depth: 5.70 m

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)	Swelling Pressure, (kN/m ²)
		Field Value, N _f	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plasticity Index (%)	Shrinkage Limit, (%)	Bulk Density (gm/cm ³)	Dry Density (gm/cm ³)	Moisture Content (%)		Type of Test	Confining Pressure, (kN/cm ²)	Cohesion Intercept, 'c' (kg/cm ²)	Angle of Internal Friction, ϕ (degrees)		
From	To																						
0.00	0.50	DS1			Stiff grey sandy silt with gravels, low plastic (CL)		24	12	54	10				1.77	1.55	14.3		UC		12			
1.00	1.45	UDS1																					
2.00	2.45	SPT1	12	16																			
4.00	4.45	UDS2																					
5.00	5.45	SPT2	18	19	Medium dense brown silty fine sand (SM)	5.00	5	40	50	5				1.95	1.68	17.4		UU	1.2	1.0	15.2		
7.00	7.45	DS2					0	82	18	0													
8.00	8.45	SPT3	15	14		10.00																	
10.00	10.45	DS3																					
11.00	11.45	SPT4	38	34	Dense grey fine sand (S ² -SM)		0	91	9	0													
13.00	13.45	DS4																					
14.00	14.45	SPT5	32	27																			
16.00	16.45	DS5																					

⁽¹⁾ SPT is carried out in accordance with IS 2959-1966.

Project No. 217166

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Preliminary Geo technical Investigation for 2x660 MW Khurja Super Thermal Power Project at Khurja, Uttar Pradesh
M/s. THDC India Limited



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Certified Laboratory
(NABL)
Certificate No. T-1741

Soil Profile (BH-20)

Boring Method: Shell & Auger
Casing Depth: 30.0 m
Boring Start: 11-Jan-18
Boring Finish: 12-Jan-18

Termination Capth: 30.45 m
Ground Water Depth: 5.70 m

Location: Area-2
UTM Coordinates: 785916 E, 3118329 N

Depth, m	Sample No	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)	Swelling Pressure, (kN/m ²)
		Field Value, N _s	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Shrinkage Limit, (%)	Bulk Density (g/cm ³)	Dry Density (g/cm ³)	Moisture Content (%)		Type of Test	Confining Pressure, (kN/cm ²)	Cohesion Intercept, c' (kg/cm ²)	Angle of Internal Friction, ϕ (degrees)		
17.00-17.45	SPT6	53	42		Very dense grey fine sand (SP-SM)	20.00	0	35	54	11	32.0	18.7	13.3	2.02	1.70	19.2		UU	1.2, 3	0.7	3.8		
19.00-19.45	DSE																						
20.00-20.45	SPT7	28	21		Very stiff brown sandy silt, low plastic (CL)																		
22.00-22.45	UDS3																						
22.00-22.45	UDS3					23.00	0	80	20	0								DS	1.2, 3	0.0	32.9		
23.00-23.45	SPT8	55	39		Very dense brown silty fine sand (SM)																		
25.00-25.45	DS7																						
26.00-26.45	SPT9	71	48																				
28.00-28.45	DSE																						
30.00-30.45	SPT10	83	53			30.45																	

⁽¹⁾ SPT as per IS 2959, 1966

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Soil Profile (BH-21)

ISO/IEC 17025:2005
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Location : Area-2
UTM Coordinates : 786024 E, 3118574 N

Termination Depth : 35.45 m
Ground Water Depth : 6.00 m

Boring Method : Shell & Auger
Casing Depth : 33.5 m
Boring Start : 21-Feb-18
Boring Finish : 22-Feb-18

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Shrinkage Limit, (%)	Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)
		Field Value, N _r	Corrected Value, N _r				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)	Moisture Content (%)		Type of Test	Confining Pressures, (kg/cm ²)	Cohesion Intercept, c' (kg/cm ²)	Angle of Internal Friction, φ (degrees)	
0.00	DS1				Stiff grey clayey silt, medium plastic (CI)	4.00	0	8	74	18	35.3	23.1	12.2	1.77	1.66	6.8		UC	2.0				
1.00	UDS1	14	18																				
2.50	SPT1																						
4.00	UDS2				Stiff grey sandy silt, low plastic (CL)	7.00	0	17	70	13				1.90	1.74	9.4	2.67	DS	0.5, 1, 1.5	0.0	34.9		
5.50	SPT2	11	11																				
7.00	UDS3																						
8.50	SPT3	16	15		Medium dense grey silty fine sand (SM)	11.50	0	66	32	2				1.96	1.68	16.7							
10.00	UDS4																						
11.50	SPT4	22	19																				
13.00	DS2				Medium dense grey fine sand (SP-SM)		2	88	10	0				1.99	1.73	14.9		DS	0.5, 1, 1.5	0.0	31.5		
14.50	SPT5	28	23																				
16.00	DS3																						

⁽¹⁾ SPT is outside NABL scope.

Project No. 218024

Plate 43 of 315



Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

Soil Profile (BH-21)



ISO/IEC 17025:2005
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(NABL)
Certificate No. T-1741

Location : Area-2
UTM Coordinates : 786024 E, 3118574 N

Termination Depth : 35.45 m
Ground Water Depth : 6.00 m

Boring Method : Shell & Auger
Casing Depth : 33.5 m
Boring Start : 21-Feb-18
Boring Finish : 22-Feb-18

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis						Atterberg Limits				Shrinkage Limit, (%)	Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)
		Field Value, N _p	Corrected Value, N _p				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)	Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)	Moisture Content (%)		Type of Test	Confining Pressures, (kg/cm ²)	Cohesion Intercept, c ² (kg/cm ²)		Angle of Internal Friction, φ (degrees)				
From 17.50 to 19.00	SPT6	34	27		Dense to very dense grey fine sand (SP-SM) - dense, 17.5 to 29.5 m																					
	DS4																									
20.50 to 20.95	SPT7	37	27																							
22.00 to 22.50	DS5																									
23.50 to 23.95	SPT8	45	32		- with gravels, 25.0 to 26.5 m		5	87	8	0																
25.00 to 25.50	DS6																									
26.50 to 26.95	SPT9	49	33																							
28.00 to 28.50	DS7																									
29.50 to 29.95	SPT10	62	39		- very dense, 29.5 to 35.0 m																					
31.00 to 31.50	DS8																									
32.50 to 32.95	SPT11	69	42				0	92	8	0																
34.00 to 34.50	DS9																									

⁽¹⁾ SPT is outside MDD scope.

Project No. 218024

Plate 44 of 315



Geotechnical Investigation for 2x660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited



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Certificate No. T-1741

Soil Profile (BH-21)

Location : Area-2
UTM Coordinates : 786024 E, 3118574 N

Termination Depth : 35.45 m
Ground Water Depth : 6.00 m

Boring Method : Shell & Auger
Casing Depth : 33.5 m
Boring Start : 21-Feb-18
Boring Finish : 22-Feb-18

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis						Atterberg Limits			Shrinkage Limit, (%)	Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)
		Field Value, N_f	Corrected Value, N_c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)	Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)		Moisture Content (%)	Type of Test	Confining Pressures, (kg/cm ²)		Cohesion Intercept, c (kg/cm ²)	Angle of Internal Friction, ϕ (degrees)			
From 35.00 to 35.45	SPT12	74	43		Very dense grey fine sand (SP-SM)	35.45																			

⁽¹⁾ SPT is as per NABL scope.

Project No. 218024

Plate 45 of 315



Geotechnical Investigation for 2x660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

Soil Profile (BH-22)



Boring Method : Shell & Auger
Casing Depth : 23.0 m
Boring Start : 22-Feb-18
Boring Finish : 23-Feb-18

Termination Depth : 25.45 m
Ground Water Depth : 5.54 m

Location : Area-2
UTM Coordinates : 796140 E, 3118388 N

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)	
		Field Value, N _r	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)	Shrinkage Limit, (%)	Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)		Moisture Content (%)	Type of Test	Confining Pressures, (kg/cm ²)	Cohesion Intercept, 'c' (kg/cm ²)		Angle of Internal Friction, φ (degrees)
	To																						
0.00	DS1				Firm grey clayey silt with gravels, medium plastic (CI)		9	8	68	15	35.5	15.7	19.9		1.98	1.86	18.8	2.70	UU	1, 2, 3	1.0	15.5	0
1.00	SPT1	7	11																				
2.50	UDS1				Stiff grey sandy silt with traces of gravel, low plastic (CL)	4.00	4	38	48	9					1.98	1.63	16.2		DS	0.5, 1, 1.5	0.0	33.3	
4.00	SPT2	15	17			7.00																	
5.50	UDS2				Medium dense grey fine sand (SP-SM)		0	89	11	0													
7.00	SPT3	16																					
8.50	UDS3				Very stiff brown sandy silt, low plastic (CL)	10.00																	
10.00	SPT4	16	15			11.50																	
11.50	UDS4				Medium dense grey fine sand (SP-SM)										2.01	1.74	15.8		DS	0.5, 1, 1.5	0.0	32.7	
13.00	SPT5	20	17			14.50																	
14.50	DS2				Medium dense grey silty fine sand (SM)		0	81															
16.00	SPT6	22	18			17.50																	

⁽¹⁾ SPT is called HALL test.

Project No. 218024

Plate 46 of 315

CLAUSE NO.



SCOPE AND SPECIAL TECHNICAL REQUIREMENTS





Geotechnical Investigation for 2x660 MW Khurja Super Thermal Power Project at Khurja, Dist. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

Soil Profile (BH-22)

ISO/IEC 17025 2005
Certified Laboratory
(NABL)
Certificate No. T-1741



Location : Area-2
UTM Coordinates : 765140 E, 3118385 N

Termination Depth : 25.45 m
Ground Water Depth : 6.54 m

Boring Method : Shell & Auger
Casing Depth : 23.0 m
Boring Start : 22-Feb-18
Boring Finish : 23-Feb-18

Depth, m	Sample No.	SPT (N)		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Shrinkage Limit, (%)	Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)
		Field Value, N _f	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)	Moisture Content (%)		Type of Test	Confining Pressures, (kg/cm ²)	Cohesion Intercept, 'c' (kg/cm ²)	Angle of Internal Friction, ϕ (degrees)	
From	DS3				Medium dense to dense grey fine sand with traces of gravel (SP-SM) - medium dense, 17.5 to 22.0 m		2	88	10	0													
To	SPT7	28	22																				
	DS4				- dense, 22.0 to 25.0 m	23.00																	
	SPT8	33	24																				
	DS5				Very stiff brown clayey silt with gravels, medium plastic (CI)		10	8	84	18	36.7	21.0	14.8										
	SPT9	24	24																				
						25.45																	

Part A includes SML scope.

Project No. 218024

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Geotechnical Investigation for 2x660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited



ISO/IEC 17025:2005
Certified Laboratory
(NABL)

Certificate No. T-1741

Soil Profile (BH-23)

Location : Area-1
UTM Coordinates : 786316 E, 3117868 N

Termination Depth : 20.45 m
Ground Water Depth : 4.60 m

Boring Method : Shell & Auger
Casing Depth : 18.5 m
Boring Start : 12-Feb-18
Boring Finish : 12-Feb-18

Depth, m	Sample No.	SPT ⁽¹⁾		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Shrinkage Limit, (%)	Density and Moisture			Shear Tests						
		Field Value, N _f	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)	Moisture Content (%)	Type of Test	Confining Pressures, (kg/cm ²)	Cohesion Intercept, c' (kg/cm ²)	Angle of Internal Friction, ϕ (degrees)	Free Swell Index, (%)		
0.00	DS1				Very stiff brown clayey silt, medium plastic (CI)	2.50																		
1.00	UDS1																							
2.50	SPT1	18	23		Medium dense gray silty fine sand (SM)		0	58	41	1		38.8	17.4	21.4	1.93	1.56	24.2		UU	1, 2, 3	0.7	6.1	0	
4.00	UDS2																			DS	0.5, 1, 1.5	0.0	31.0	
5.50	SPT2	21	22																					
7.00	UDS3				Medium dense to dense gray fine sand (SP-GM) - medium dense, 8.5 to 14.5 m - dense, 14.5 to 17.5 m	8.50	0	82	18										2.68					
8.50	SPT3	27	27																					
10.00	UDS4																							
11.50	SPT4	29	27																					
13.00	UDS5																							
14.50	SPT5	32	27				0	89	11	0					2.05	1.69	21.2		DS	0.5, 1, 1.5	0.0	32.7		
16.00	UDS6																							

Figure 1: Soil Profile, BH-23

Project No. 218024

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Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

Soil Profile (BH-23)



Location : Area-I
UTM Coordinates : 785316 E, 3117868 N
Termination Depth : 20.45 m
Ground Water Depth : 4.50 m
Boring Method : Shell & Auger
Casing Depth : 18.5 m
Boring Start : 12-Feb-18
Boring Finish : 12-Feb-18

Depth, m	Sample No.	SPT 1 ⁰		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Grain Size Analysis				Atterberg Limits			Shrinkage Limit (%)	Density and Moisture			Specific Gravity	Shear Tests				Free Swell Index, (%)	
		Field Value, N _c	Corrected Value, N _c				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gms/cm ³)	Dry Density (gms/cm ³)	Moisture Content (%)		Type of Test	Confining Pressure, (kg/cm ²)	Cohesion Intercept, c' (kg/cm ²)	Angle of Internal Friction, φ (degrees)		
From	17.50	44	36		Dense gray fine sand (SP-SM)	20.45																		
To	17.95																							
	19.38																							
	20.45	46	36																					

THDC India Limited, Noida

Project No. 218024

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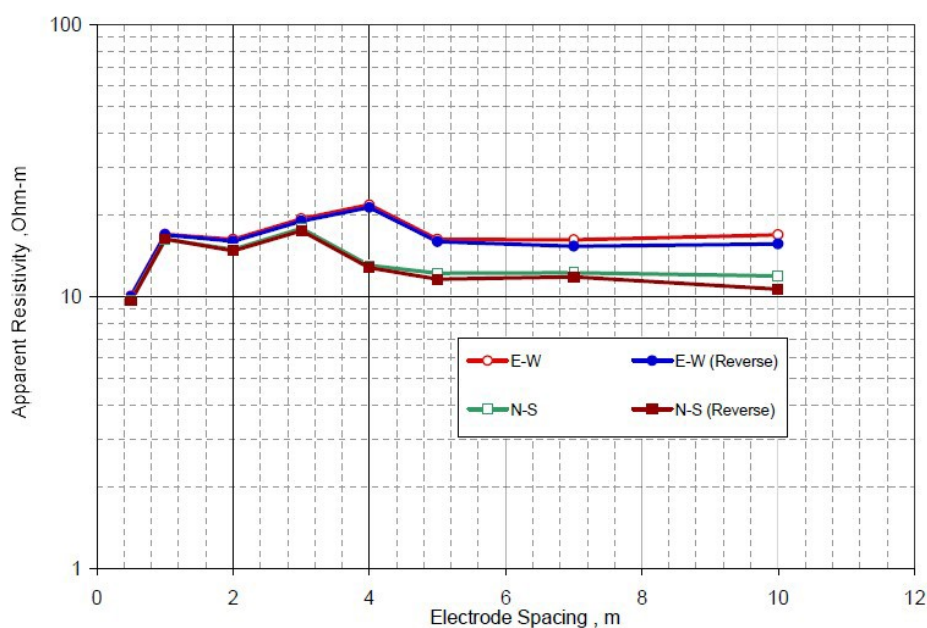
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-1**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-1
Co-ordinate : 786314E, 3118913N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	10.1	10.0	9.7	9.7
1.0	17.0	17.0	16.3	16.4
2.0	16.3	16.1	15.0	14.8
3.0	19.4	19.0	17.9	17.5
4.0	21.9	21.4	13.1	12.8
5.0	16.3	16.0	12.3	11.6
7.0	16.3	15.4	12.3	11.9
10.0	17.0	15.7	11.9	10.7
Mean Resistivity	17	16	14	13

Mean Resistivity Value, ohm-m : 11.9 ohm-m

Apparent Resistivity Values (ERT-1)

Project No. 218024

Plate 99 of 315

CLAUSE NO.



SCOPE AND SPECIAL TECHNICAL REQUIREMENTS



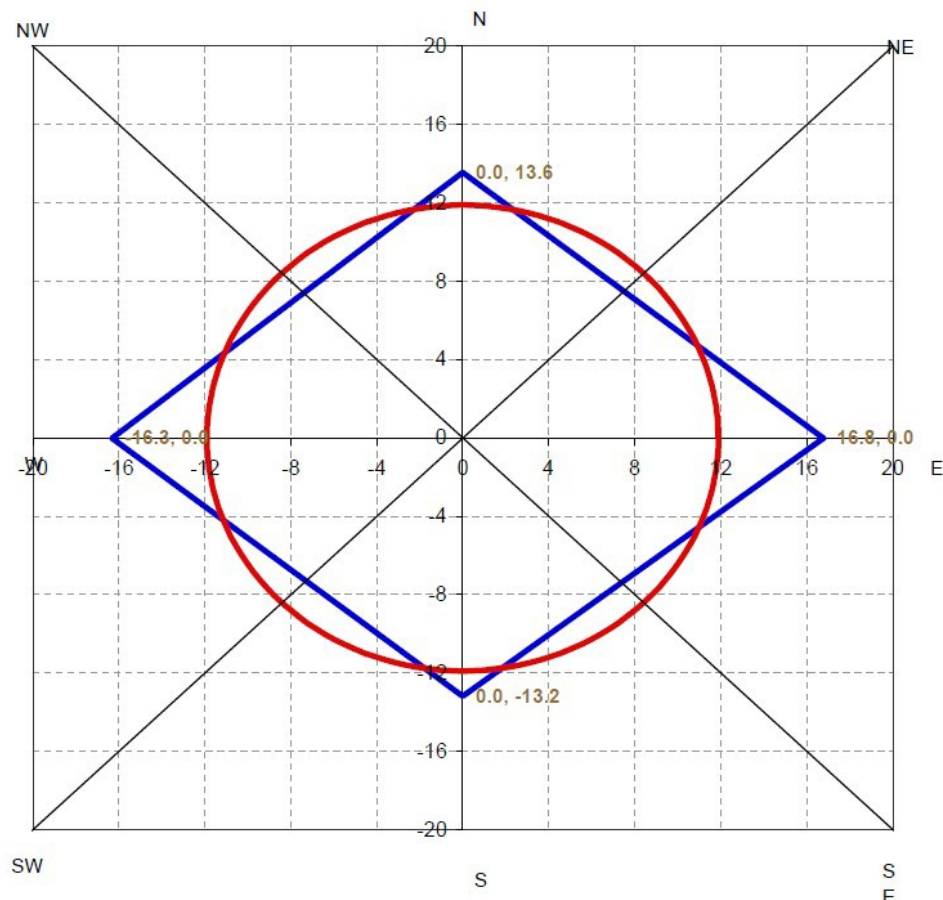
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-1**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-1
Co-ordinate : 786314E, 3118913N



Total Area of Polygon : 443

Radius of Equivalent Circle=Mean Resistivity : 12 ohm-m

Polar Resistivity Curves (ERT-1)

Project No. 218024

Plate 100 of 315

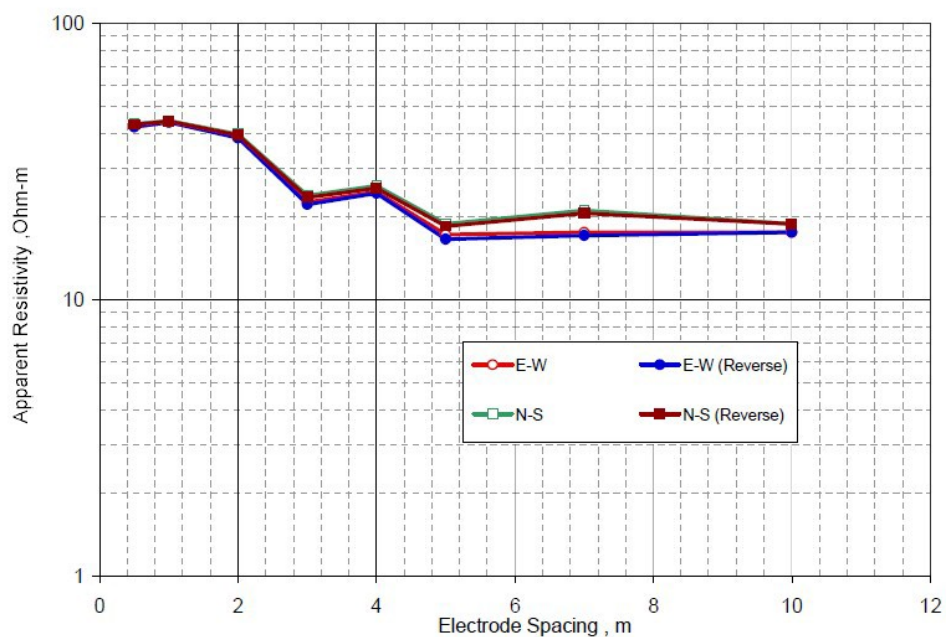
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-2**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-2
Co-ordinate : 786280E, 3119019N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	42.4	42.3	43.4	43.2
1.0	44.0	44.0	44.6	44.4
2.0	39.0	38.6	39.8	39.5
3.0	22.6	22.2	23.9	23.6
4.0	24.6	24.4	25.9	25.4
5.0	17.3	16.7	18.8	18.5
7.0	17.6	17.2	21.1	20.7
10.0	17.6	17.6	18.8	18.8
Mean Resistivity	28	28	30	29

Mean Resistivity Value, ohm-m : 22.9 ohm-m

Apparent Resistivity Values (ERT-2)

Project No. 218024

Plate 101 of 315

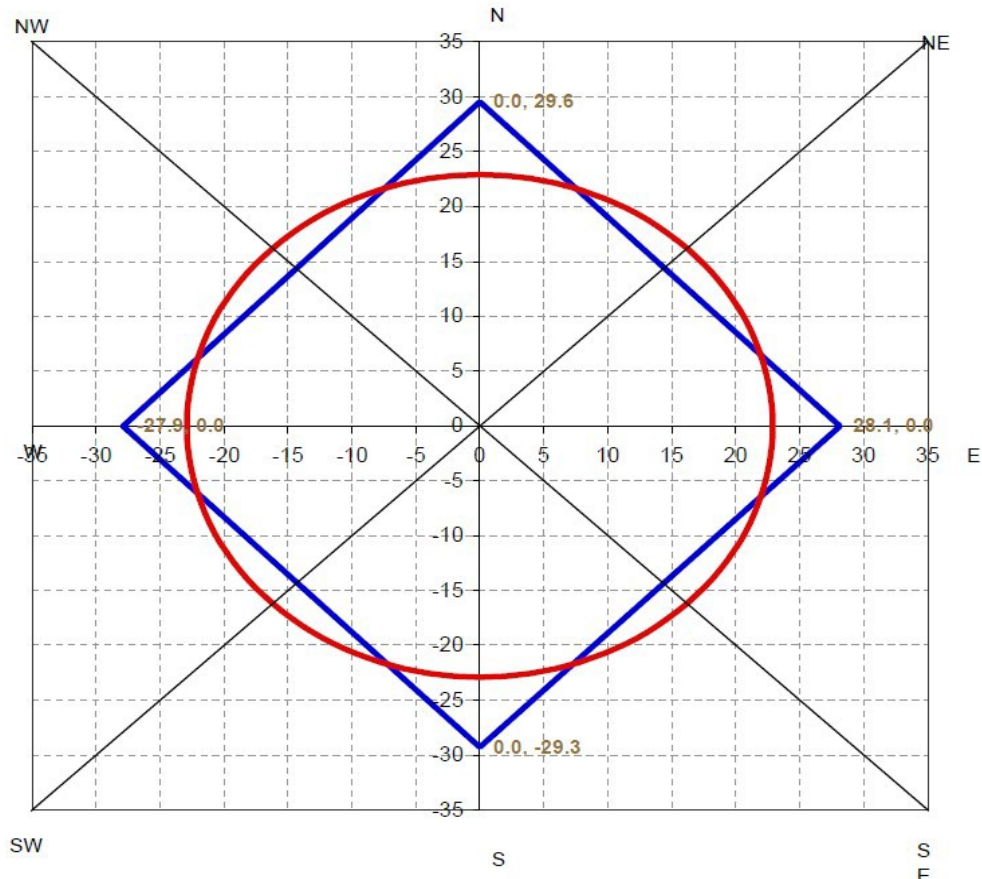
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-2**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-2
Co-ordinate : 786280E, 3119019N

**Polar Resistivity Curves (ERT-2)**

Project No. 218024

Plate 102 of 315

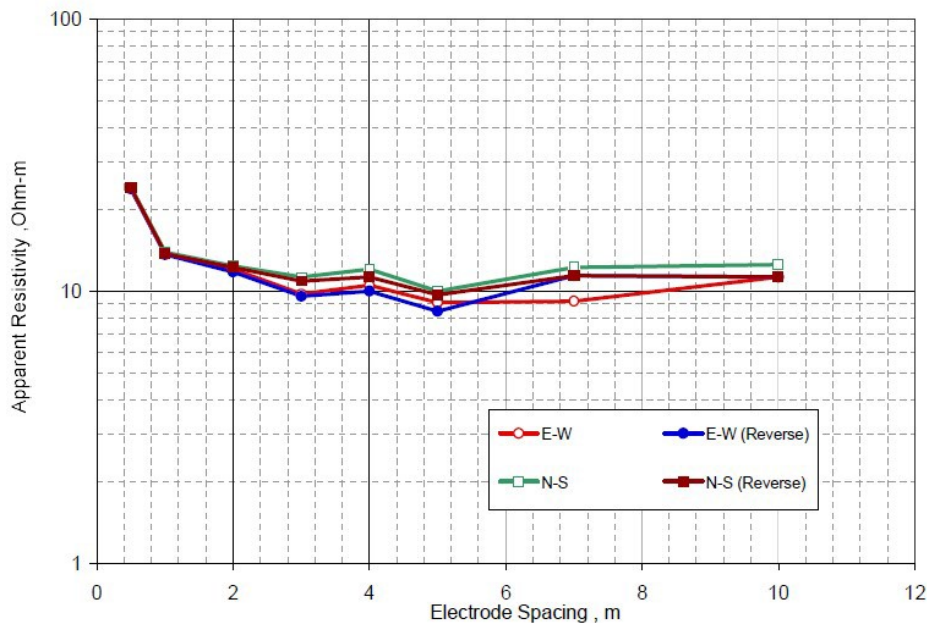
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-3**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-3
Co-ordinate : 786234E, 3118900N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	23.9	23.9	24.2	24.1
1.0	13.8	13.7	13.9	13.8
2.0	12.1	11.8	12.4	12.3
3.0	9.8	9.6	11.3	10.9
4.0	10.6	10.1	12.1	11.3
5.0	9.1	8.5	10.1	9.7
7.0	9.2	11.4	12.3	11.4
10.0	11.3	11.3	12.6	11.3
Mean Resistivity	12	13	14	13

Mean Resistivity Value, ohm-m : 10.3 ohm-m

Apparent Resistivity Values (ERT-3)

Project No. 218024

Plate 103 of 315

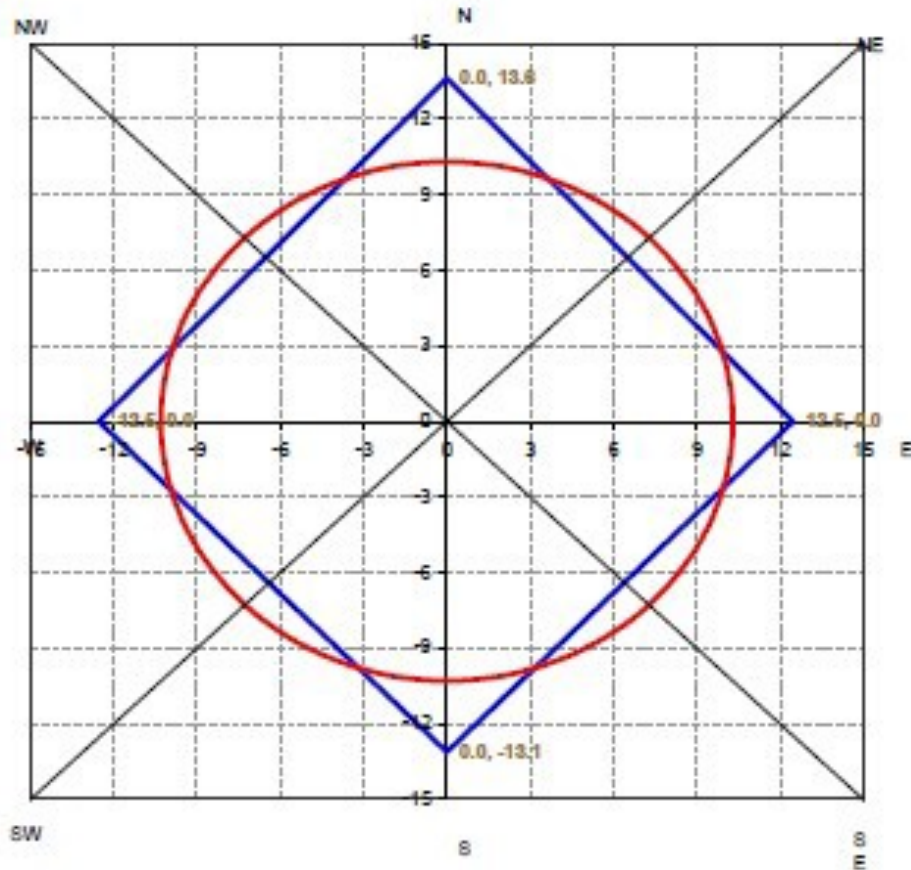
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-3**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-3
Co-ordinate : 786234E, 3118900N



Total Area of Polygon : 334
Radius of Equivalent Circle=Mean Resistivity : 10 ohm-m

Polar Resistivity Curves (ERT-3)

Project No. 210024

Plate 104 of 315

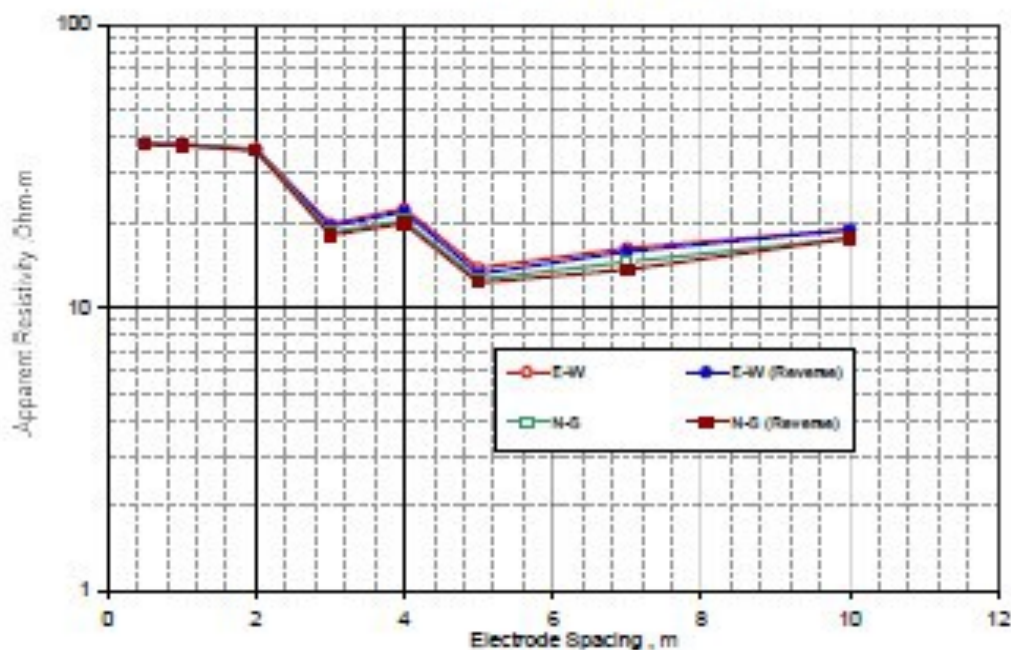
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-4**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-4
Co-ordinate : 786175E, 3119228N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	38.0	37.9	37.7	37.7
1.0	37.7	37.7	37.8	37.6
2.0	36.4	36.1	36.3	36.1
3.0	19.9	19.4	18.5	18.1
4.0	22.4	21.9	20.4	19.9
5.0	13.8	13.2	12.6	12.3
7.0	16.3	15.8	14.5	13.6
10.0	18.8	18.8	17.6	17.6
Mean Resistivity	25	25	24	24

Mean Resistivity Value, ohm-m : 19.7 ohm-m

Apparent Resistivity Values (ERT-4)

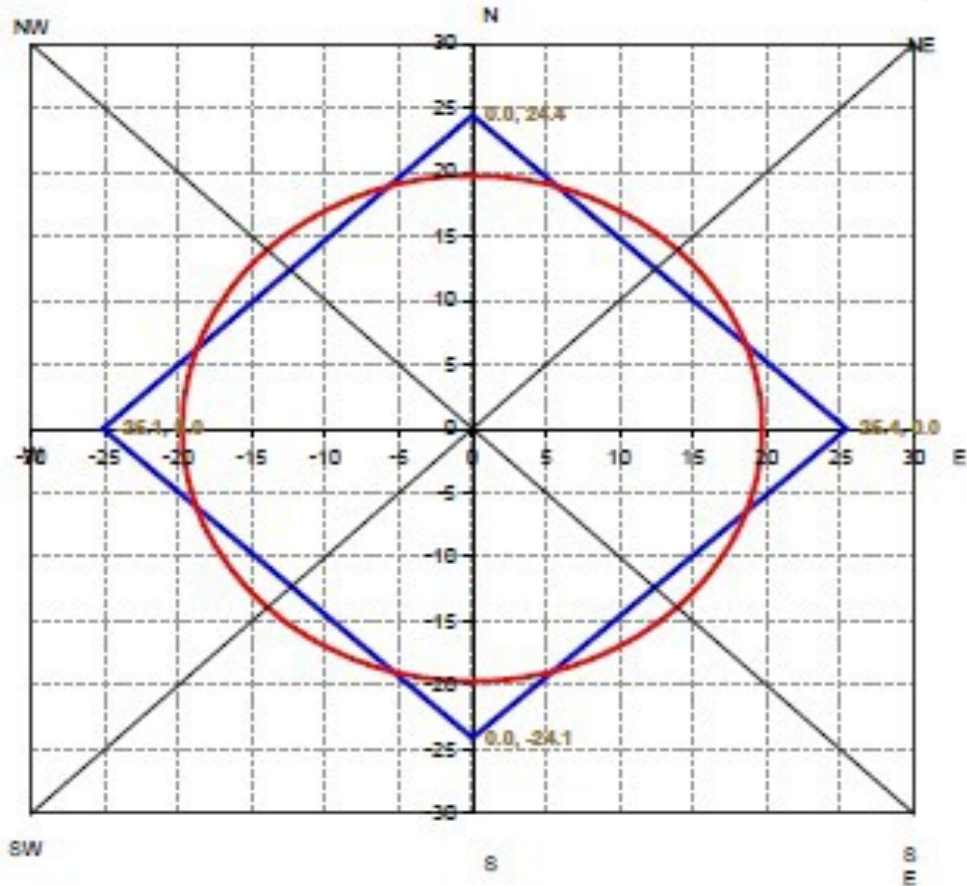
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-4**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-4
Co-ordinate : 786175E, 3119228N



Total Area of Polygon : 1225

Radius of Equivalent Circle=Mean Resistivity : 20 ohm-m

Polar Resistivity Curves (ERT-4)

Project No. Z18024

Plate 105 of 315

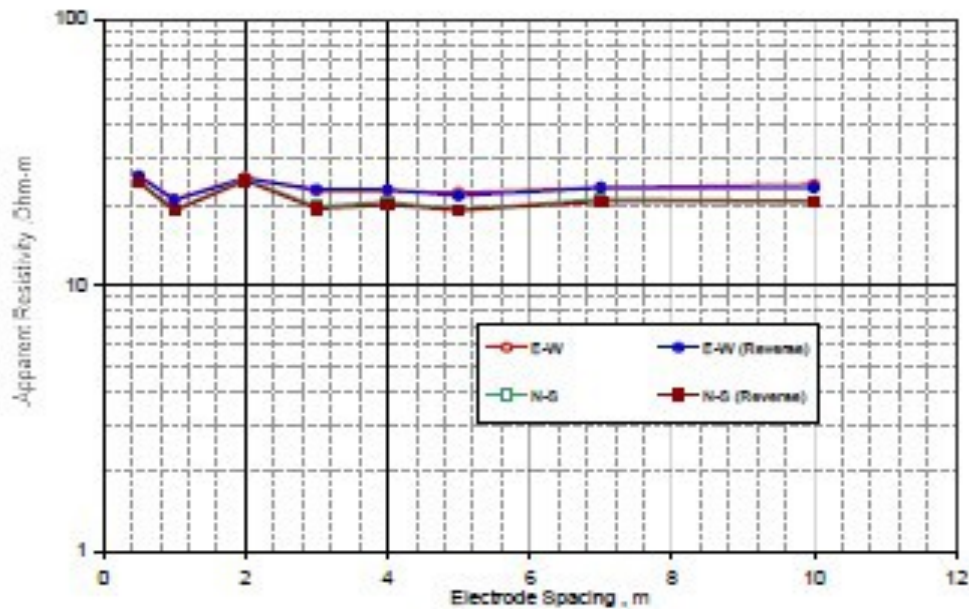
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-6**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-5
Co-ordinate : 785973E, 3118944N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	25.8	25.7	24.5	24.4
1.0	21.0	20.9	19.2	19.1
2.0	25.4	25.1	25.0	24.8
3.0	22.6	23.0	19.8	19.4
4.0	22.6	22.9	20.6	20.1
5.0	22.3	21.7	19.2	19.2
7.0	23.3	23.3	21.1	20.7
10.0	23.9	23.2	20.7	20.7
Mean Resistivity	23	23	21	21

Mean Resistivity Value, ohm-m : 17.7 ohm-m

Apparent Resistivity Values (ERT-6)

Project No: 210024

Plate 107 of 315

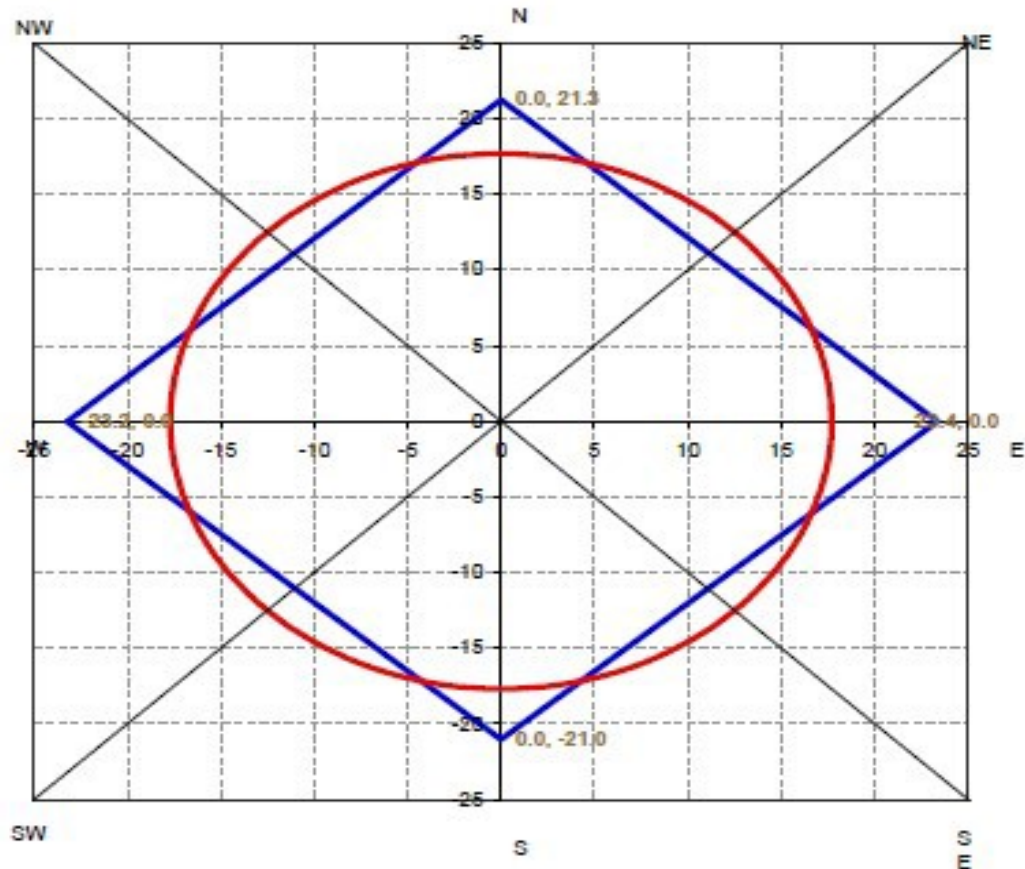
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-5**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-5
Co-ordinate : 785973E, 3118944N



Total Area of Polygon : 986

Radius of Equivalent Circle-Mean Resistivity : 18 ohm-m

Polar Resistivity Curves (ERT-5)

Project No. 218024

Plate 108 of 315

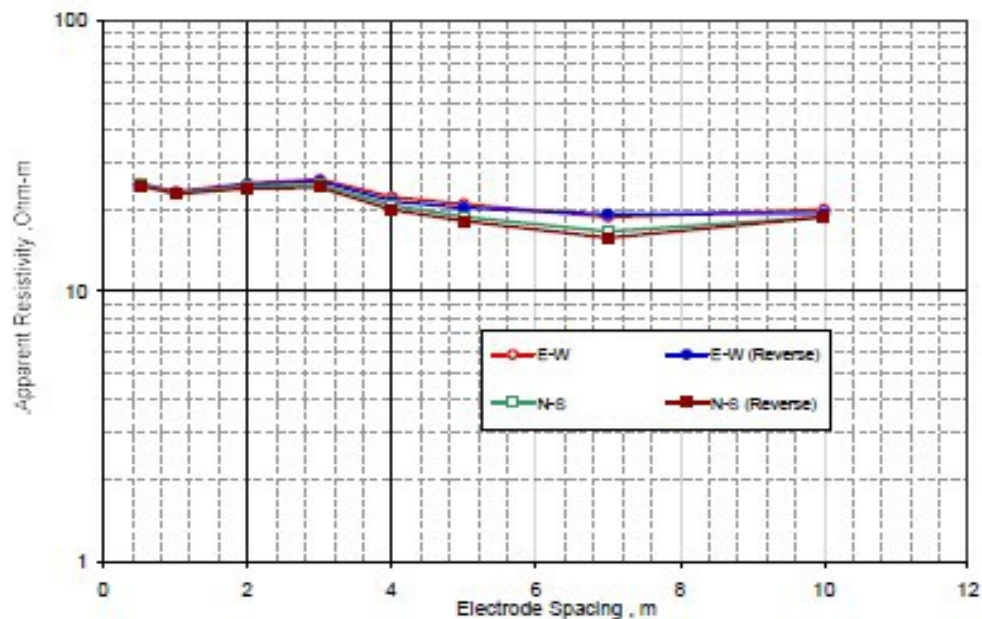
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-6**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-6
Co-ordinate : 786142E, 3118643N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	25.1	25.0	24.8	24.7
1.0	23.4	23.2	23.1	23.0
2.0	25.1	24.9	24.5	24.1
3.0	26.0	25.6	24.9	24.3
4.0	22.4	21.6	20.9	20.1
5.0	21.0	20.4	18.8	18.2
7.0	18.9	19.4	16.7	15.8
10.0	20.1	19.5	18.8	18.8
Mean Resistivity	23	22	22	21

Mean Resistivity Value, ohm-m : 17.5 ohm-m

Apparent Resistivity Values (ERT-6)

Project No. 218024

Plate 109 of 315

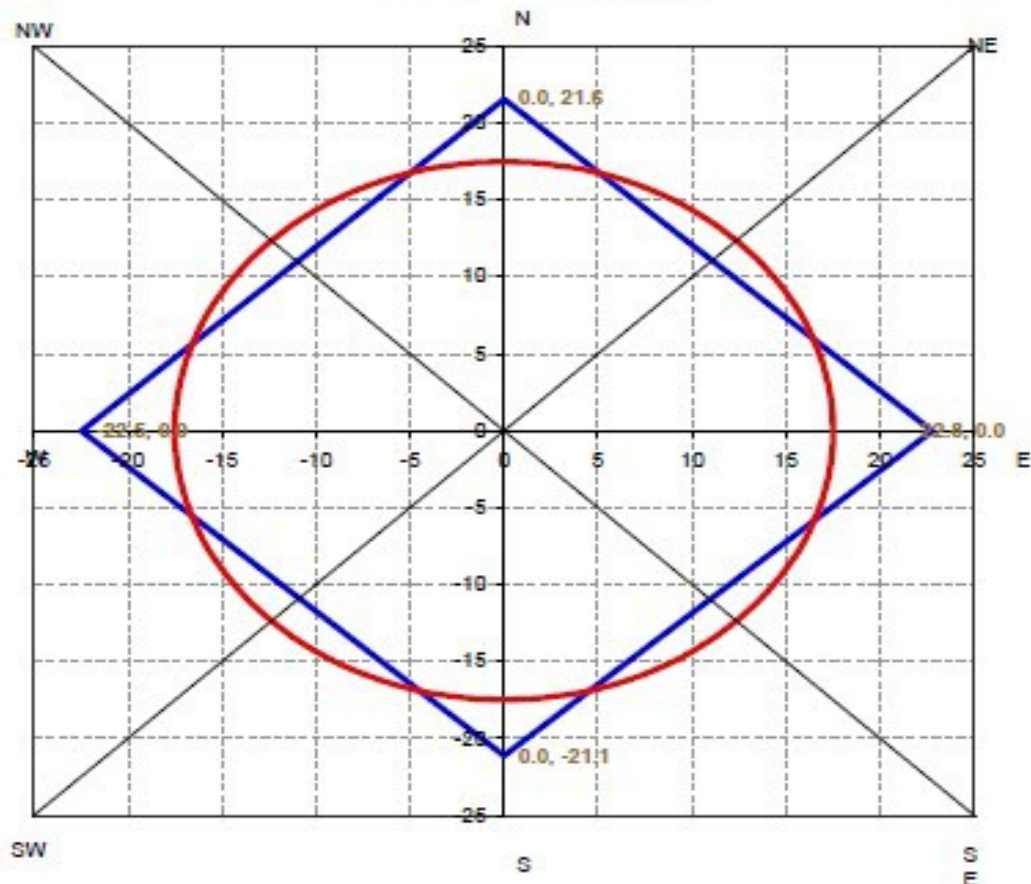
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-6**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-6
Co-ordinate : 786142E, 3118643N



Total Area of Polygon : 966

Radius of Equivalent Circle=Mean Resistivity : 18 ohm-m

Polar Resistivity Curves (ERT-6)

Project No. 218024

Plate 110 of 315

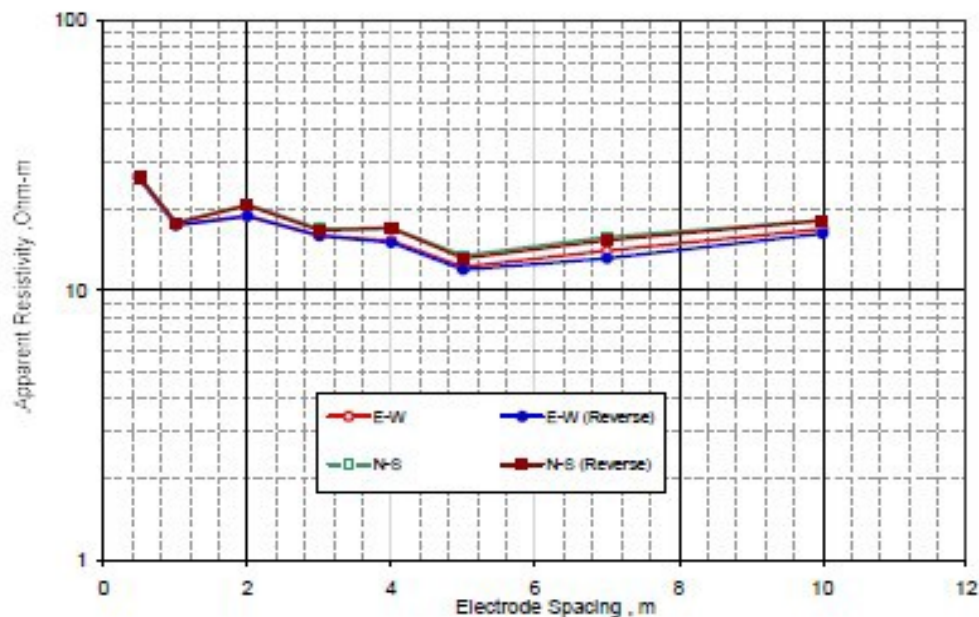
Geotechnical Investigation for 2X660 MW Kurja Super Thermal Power Project at Kurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-7**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-7
Co-ordinate : 785964E, 3118820N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	26.1	26.0	26.3	26.3
1.0	17.5	17.5	17.9	17.8
2.0	19.0	18.8	20.9	20.7
3.0	16.0	16.0	17.0	16.8
4.0	15.3	15.1	17.1	17.1
5.0	12.3	11.9	13.5	13.2
7.0	14.1	13.2	15.8	15.4
10.0	17.0	16.3	18.2	18.2
Mean Resistivity	17	17	18	18

Mean Resistivity Value, ohm-m : 14.1 ohm-m

Apparent Resistivity Values (ERT-7)

Project No. 218024

Plate 111 of 315

CLAUSE NO.



SCOPE AND SPECIAL TECHNICAL REQUIREMENTS



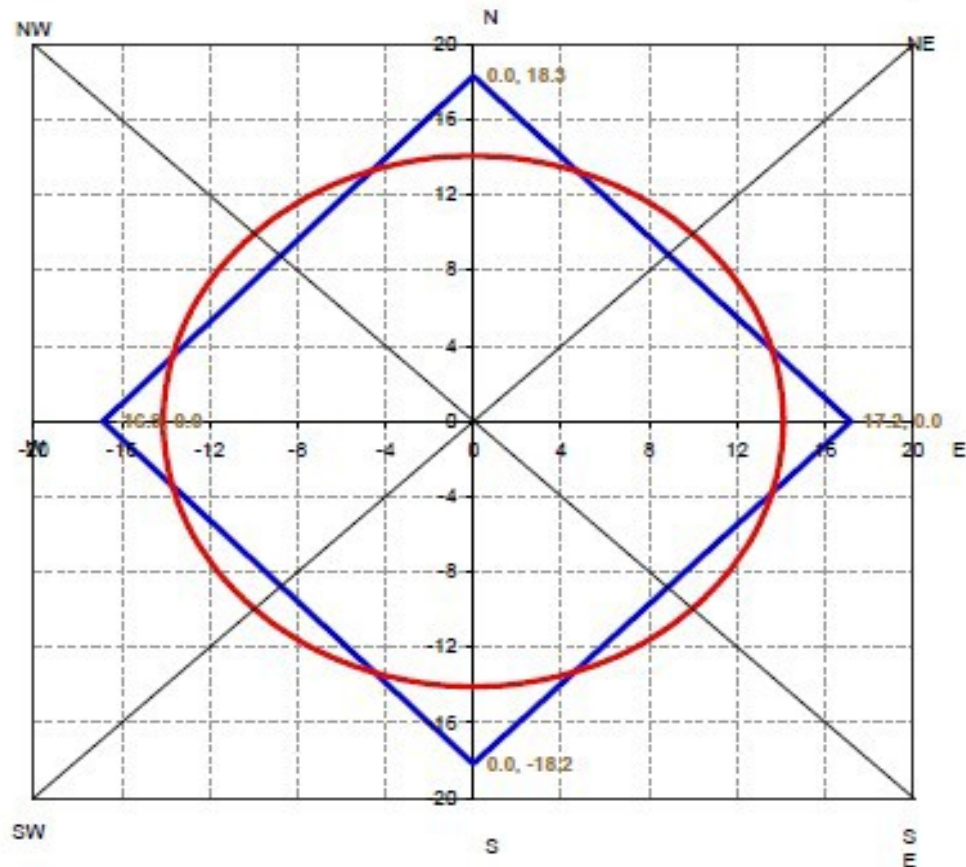
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-7**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-7
Co-ordinate : 785964E, 3118820N



Total Area of Polygon : 621

Radius of Equivalent Circle-Mean Resistivity : 14 ohm-m

Polar Resistivity Curves (ERT-7)

Project No. 218024

Plate 112 of 315

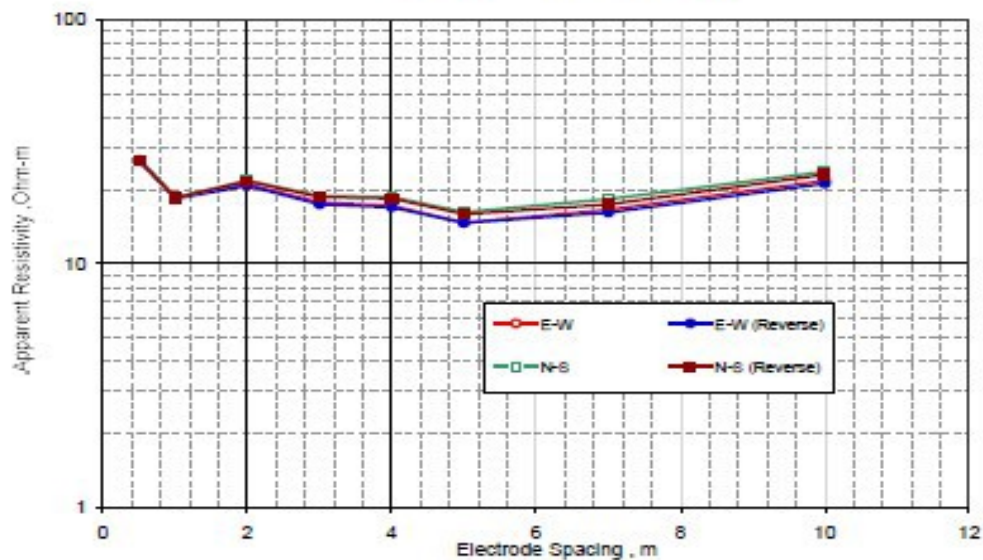
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-8**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-8
Co-ordinate : 785939E, 3118664N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	26.7	26.6	26.8	26.7
1.0	18.7	18.5	18.8	18.7
2.0	21.2	21.0	22.0	21.9
3.0	17.9	17.5	19.0	18.8
4.0	17.3	17.1	18.8	18.6
5.0	14.8	14.8	16.3	16.0
7.0	16.7	16.3	18.5	17.6
10.0	22.0	21.4	23.9	23.2
Mean Resistivity	19	19	21	20

Mean Resistivity Value, ohm-m : 15.8 ohm-m

Apparent Resistivity Values (ERT-8)

Project No: 218024

Plate 113 of 315

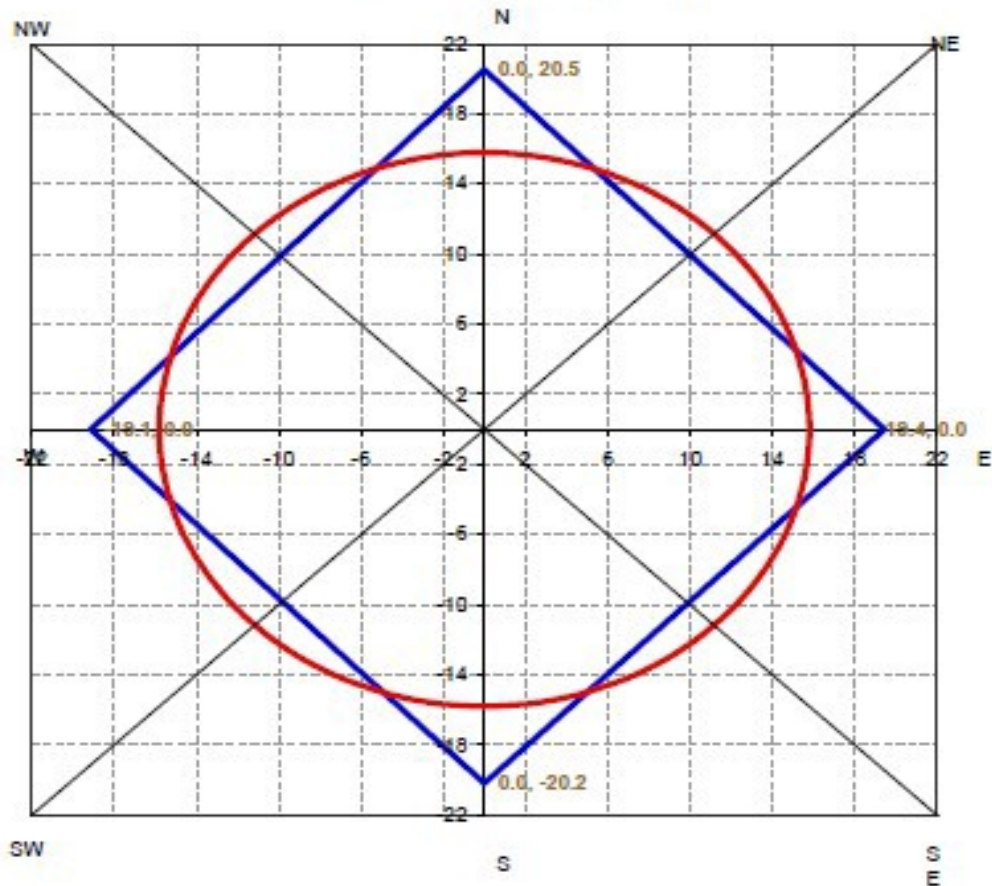
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-8**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-8
Co-ordinate : 785939E, 3118664N



Total Area of Polygon : 785

Radius of Equivalent Circle=Mean Resistivity : 16 ohm-m

Polar Resistivity Curves (ERT-8)

Project No: 218024

Plate 114 of 315

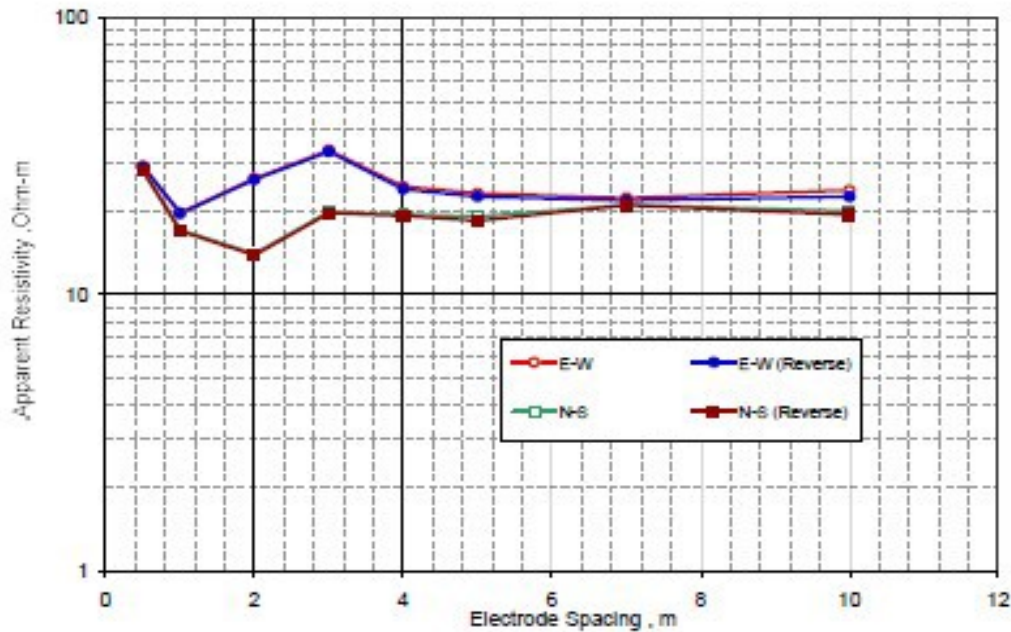
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-9**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-9
Co-ordinate : 785834E, 3118652N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	29.2	29.1	28.2	28.2
1.0	19.8	19.7	17.2	17.0
2.0	26.4	26.1	14.1	13.9
3.0	33.4	33.0	20.0	19.8
4.0	24.6	24.1	19.6	19.4
5.0	23.2	22.6	19.2	18.5
7.0	22.4	22.0	21.1	21.1
10.0	23.9	22.6	20.1	19.5
Mean Resistivity	25	25	20	20

Mean Resistivity Value, ohm-m : 17.8 ohm-m

Apparent Resistivity Values (ERT-9)

Project No. 218024

Plate 115 of 315

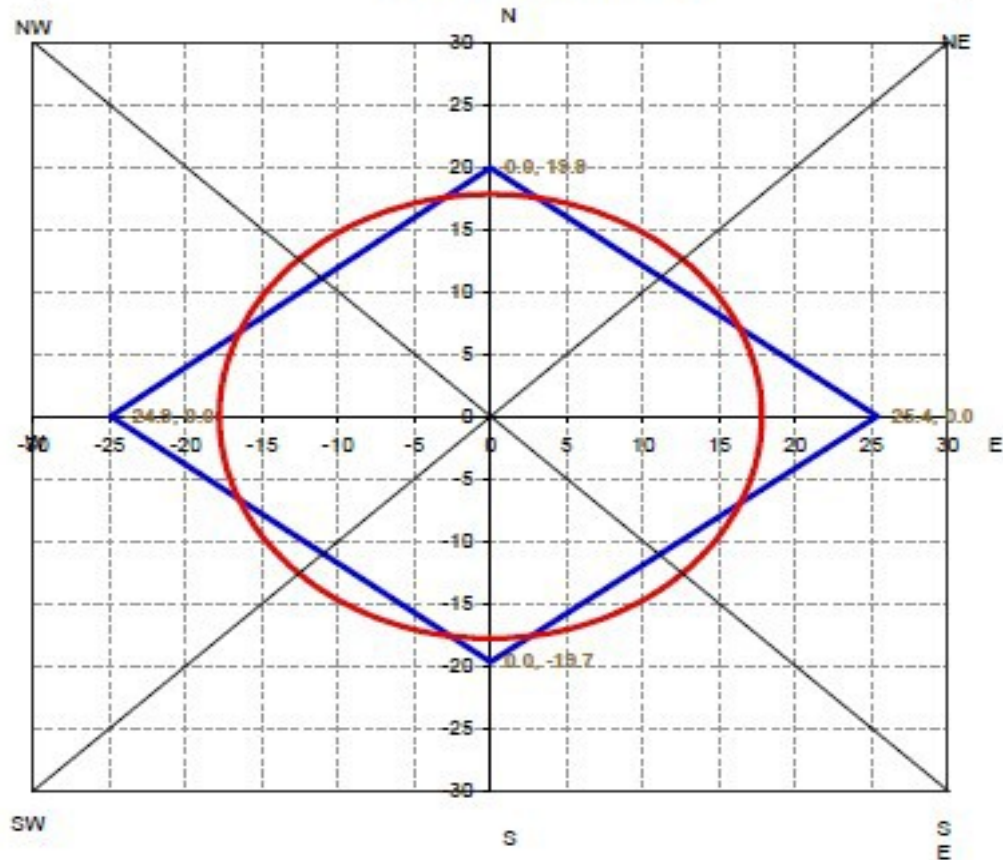
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-9**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-9
Co-ordinate : 785834E, 3118652N



Total Area of Polygon : 996

Radius of Equivalent Circle-Mean Resistivity : 18 ohm-m

Polar Resistivity Curves (ERT-9)

Project No. 218024

Plate 116 of 315

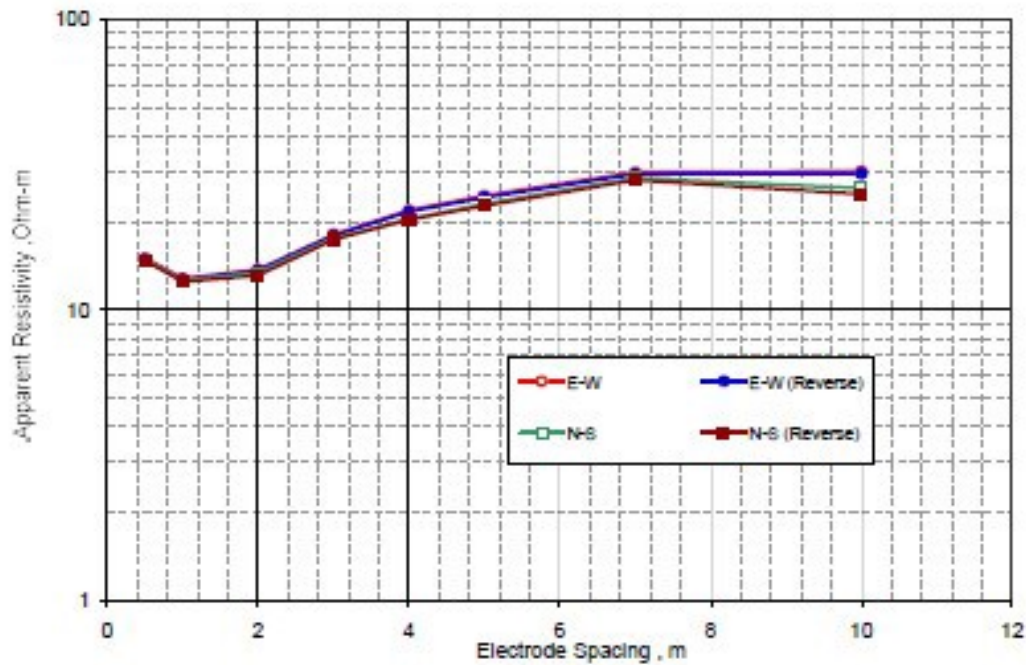
Electrical Resistivity Test No.: ERT-10

IS: 3043-1987, RA-2006

Test Details

Test Designation : ERT-10

Co-ordinate : 785502E, 3118672N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	15.1	15.0	15.0	14.9
1.0	12.9	12.8	12.6	12.6
2.0	13.8	13.7	13.4	13.2
3.0	18.3	18.1	17.7	17.5
4.0	22.1	21.9	20.6	20.6
5.0	24.8	24.5	23.2	22.9
7.0	29.9	29.5	28.6	28.1
10.0	30.2	29.5	26.4	25.1
Mean Resistivity	21	21	20	19

Mean Resistivity Value, ohm-m : 16.1 ohm-m

Apparent Resistivity Values (ERT-10)

Project No. 218024

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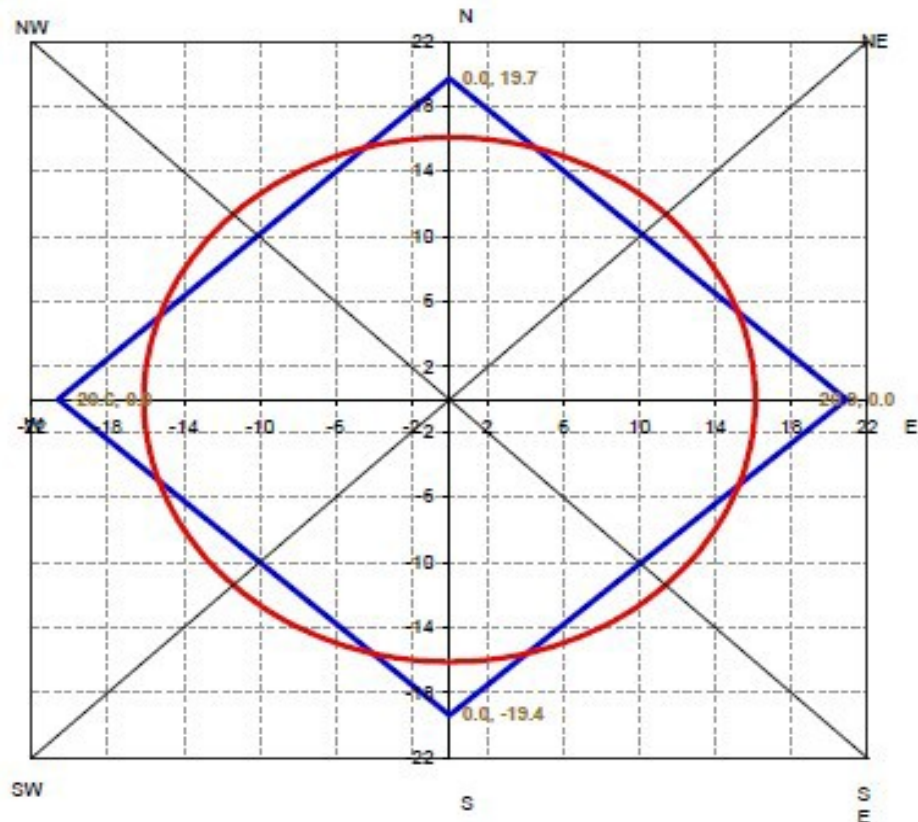
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-10**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-10
Co-ordinate : 785502E, 3118672N



Total Area of Polygon : 811

Radius of Equivalent Circle=Mean Resistivity : 16 ohm-m

Polar Resistivity Curves (ERT-10)

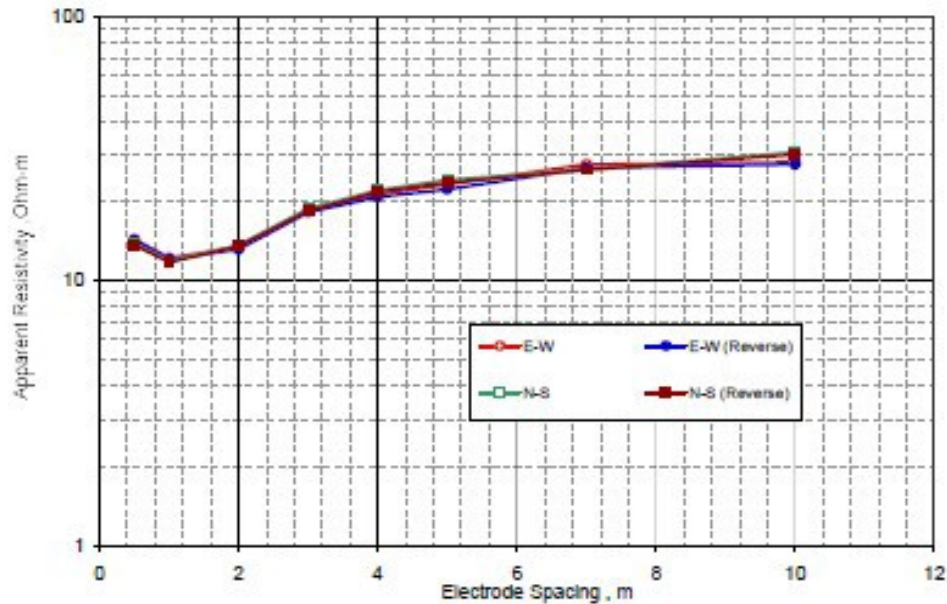
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-11**

IS: 3043-1987, RA-2006

Test Details	
Test Designation :	ERT-11
Co-ordinate :	785346E, 3118656N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	14.4	14.3	13.8	13.8
1.0	12.3	12.1	11.9	11.8
2.0	13.4	13.2	13.7	13.6
3.0	18.5	18.3	18.8	18.5
4.0	21.4	20.9	22.1	21.9
5.0	23.2	22.3	24.2	23.6
7.0	27.7	26.8	26.4	26.4
10.0	28.3	27.6	30.8	30.2
Mean Resistivity	20	19	20	20

Mean Resistivity Value, ohm-m : 15.9 ohm-m

Apparent Resistivity Values (ERT-11)

Project No: 218024

Plate 119 of 315

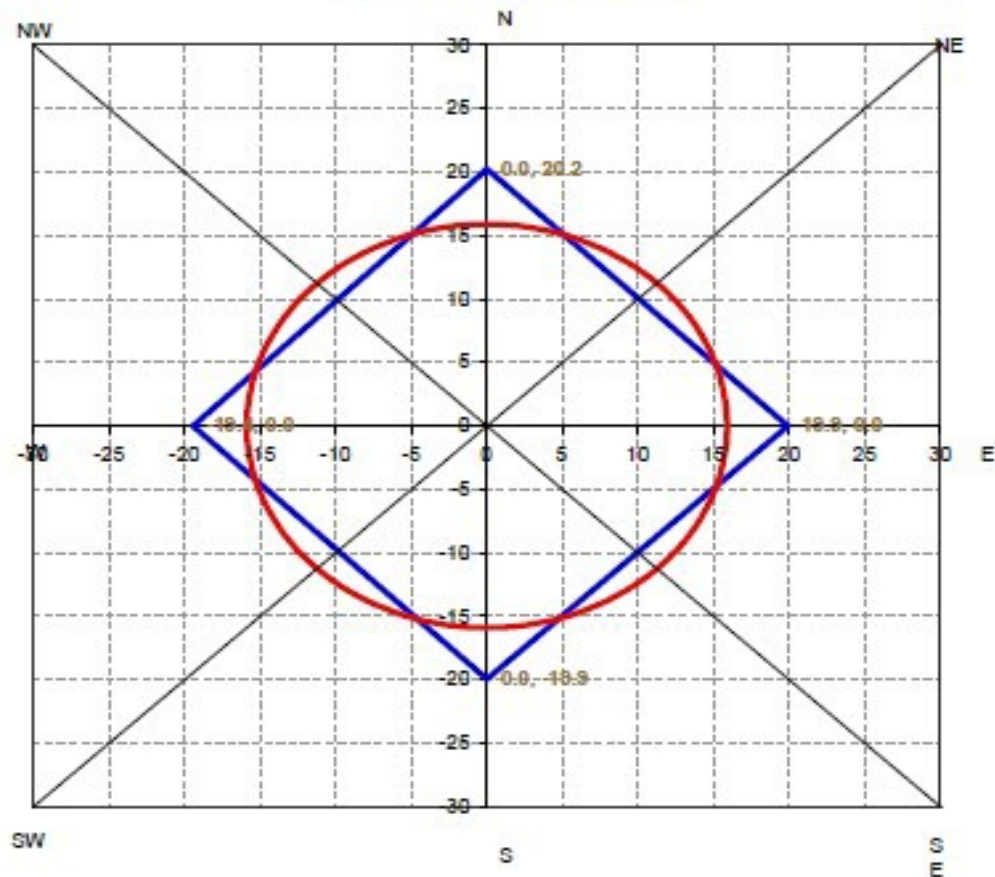
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-11**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-11
Co-ordinate : 785346E, 3118656N



Total Area of Polygon : 790

Radius of Equivalent Circle=Mean Resistivity : 16 ohm-m

Polar Resistivity Curves (ERT-11)

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Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
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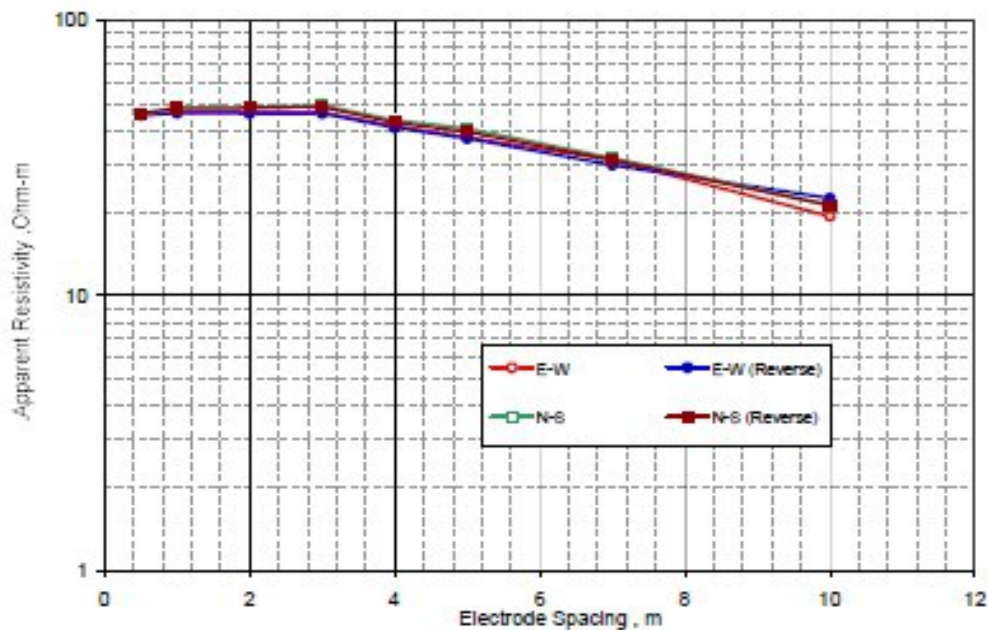
**Electrical Resistivity Test No.: ERT-12**

IS: 3043-1987, RA-2006

Test Details

Test Designation : ERT-12

Co-ordinate : 785735E, 3117990N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	45.6	45.4	46.2	46.1
1.0	46.5	46.3	48.2	48.1
2.0	46.5	46.1	48.4	48.3
3.0	46.6	46.2	49.2	48.6
4.0	41.5	41.0	43.5	42.7
5.0	37.7	37.4	40.5	39.6
7.0	31.2	29.9	31.7	31.2
10.0	19.5	22.6	21.4	21.4
Mean Resistivity	39	39	41	41

Mean Resistivity Value, ohm-m : 32 ohm-m

Apparent Resistivity Values (ERT-12)

Project No. 218024

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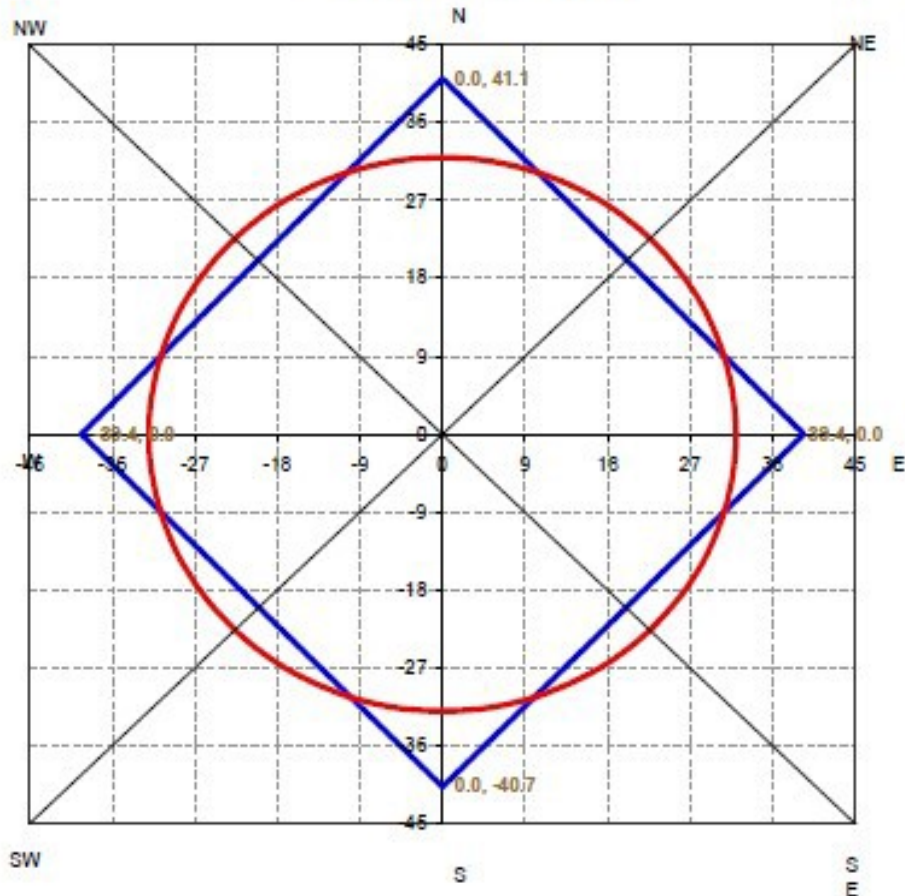
Electrical Resistivity Test No.: ERT-12

IS: 3043-1987, RA-2006

Test Details

Test Designation : ERT-12

Co-ordinate : 785735E, 3117990N



Total Area of Polygon : 3223

Radius of Equivalent Circle=Mean Resistivity : 32 ohm-m

Polar Resistivity Curves (ERT-12)

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Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
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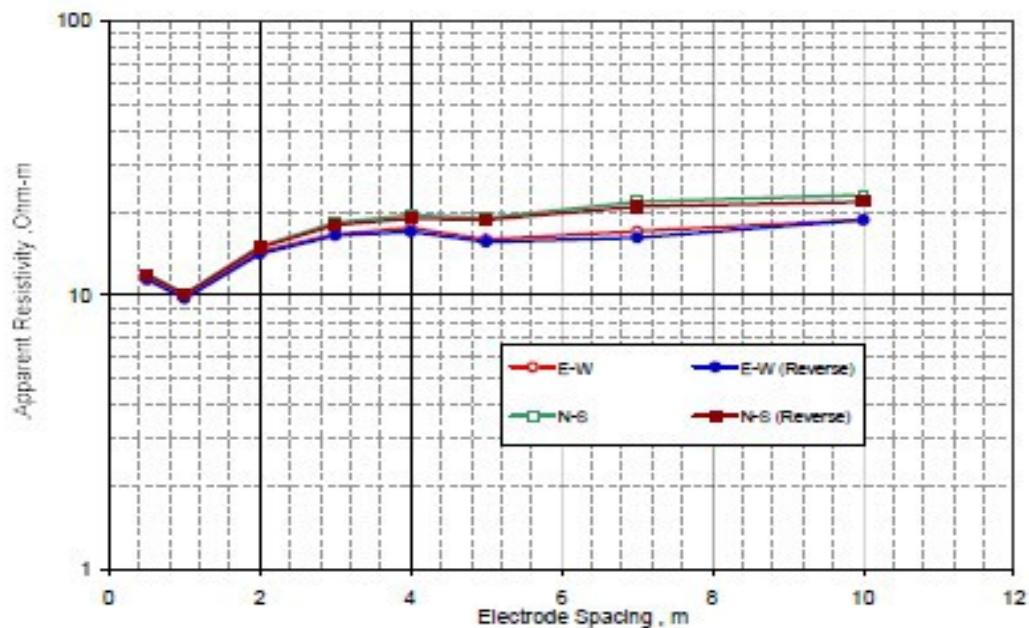
**Electrical Resistivity Test No.: ERT-13**

IS: 3043-1987, RA-2006

Test Details

Test Designation : ERT-13

Co-ordinate : 785995E, 3117973N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	11.5	11.4	11.9	11.9
1.0	9.9	9.7	10.1	10.1
2.0	14.5	14.2	15.1	15.0
3.0	16.8	16.6	18.5	18.1
4.0	17.6	17.1	19.6	19.1
5.0	16.0	15.7	19.2	18.8
7.0	17.2	16.3	22.0	21.1
10.0	18.8	18.8	23.2	22.0
Mean Resistivity	15	15	17	17

Mean Resistivity Value, ohm-m : 12.9 ohm-m

Apparent Resistivity Values (ERT-13)

Project No. 218024

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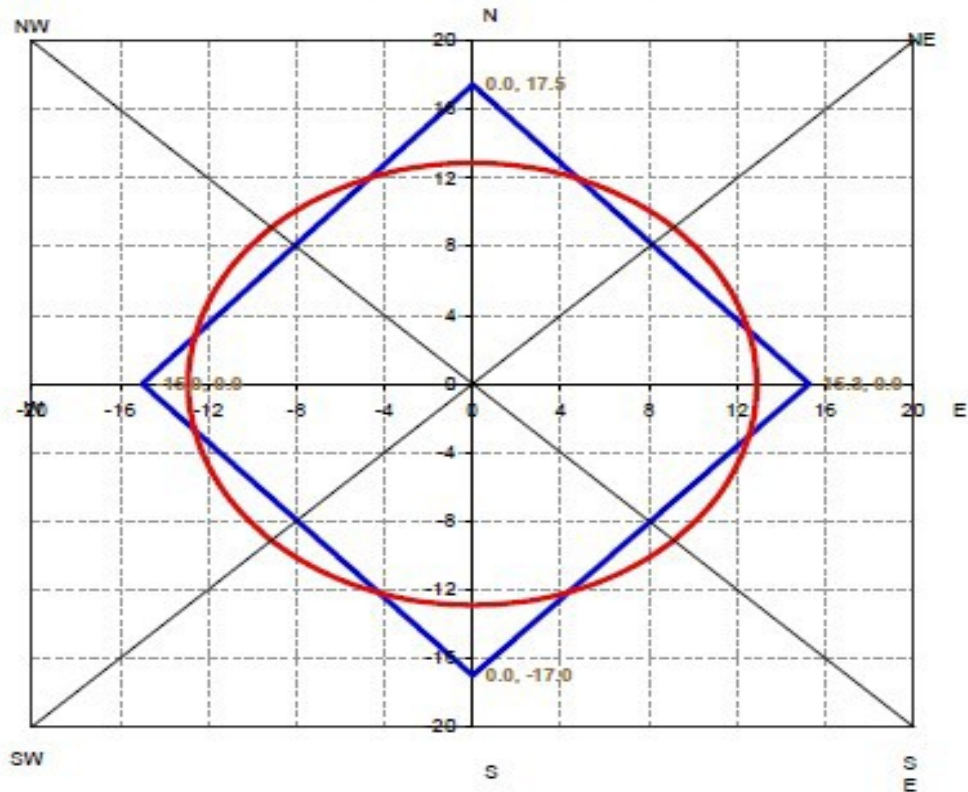
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-13**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-13
Co-ordinate : 785995E, 3117973N



Total Area of Polygon : 521

Radius of Equivalent Circle=Mean Resistivity : 13 ohm-m

Polar Resistivity Curves (ERT-13)

Project No. 218024

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Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
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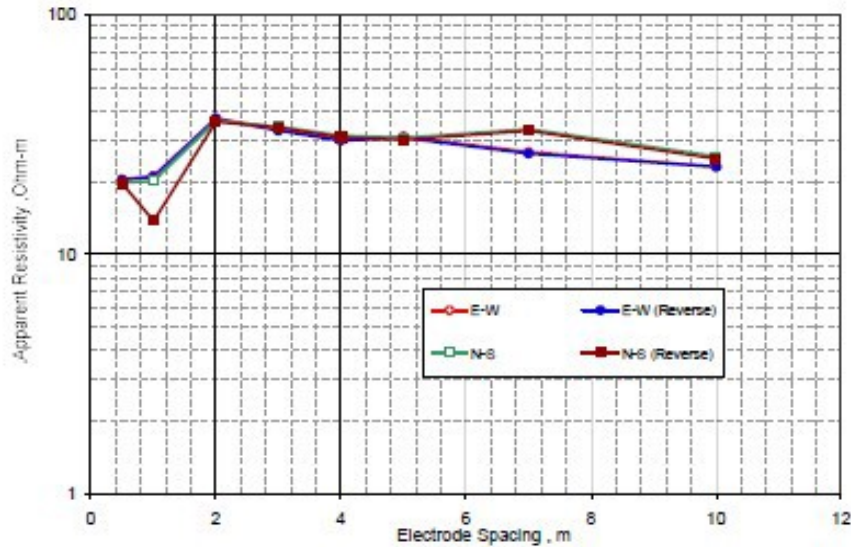
**Electrical Resistivity Test No.: ERT-14**

IS: 3043-1987, RA-2006

Test Details

Test Designation : ERT-14

Co-ordinate : 785304E, 3117715N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	20.6	20.5	19.9	19.8
1.0	21.3	21.1	20.4	13.8
2.0	37.2	36.8	36.2	35.8
3.0	33.4	33.0	34.3	33.9
4.0	30.4	29.9	31.4	30.9
5.0	31.1	30.8	30.8	30.2
7.0	26.8	26.4	33.4	33.0
10.0	23.2	23.2	25.8	25.1
Mean Resistivity	28	28	29	28

Mean Resistivity Value, ohm-m : 22.5 ohm-m

Apparent Resistivity Values (ERT-14)

Project No: 218024

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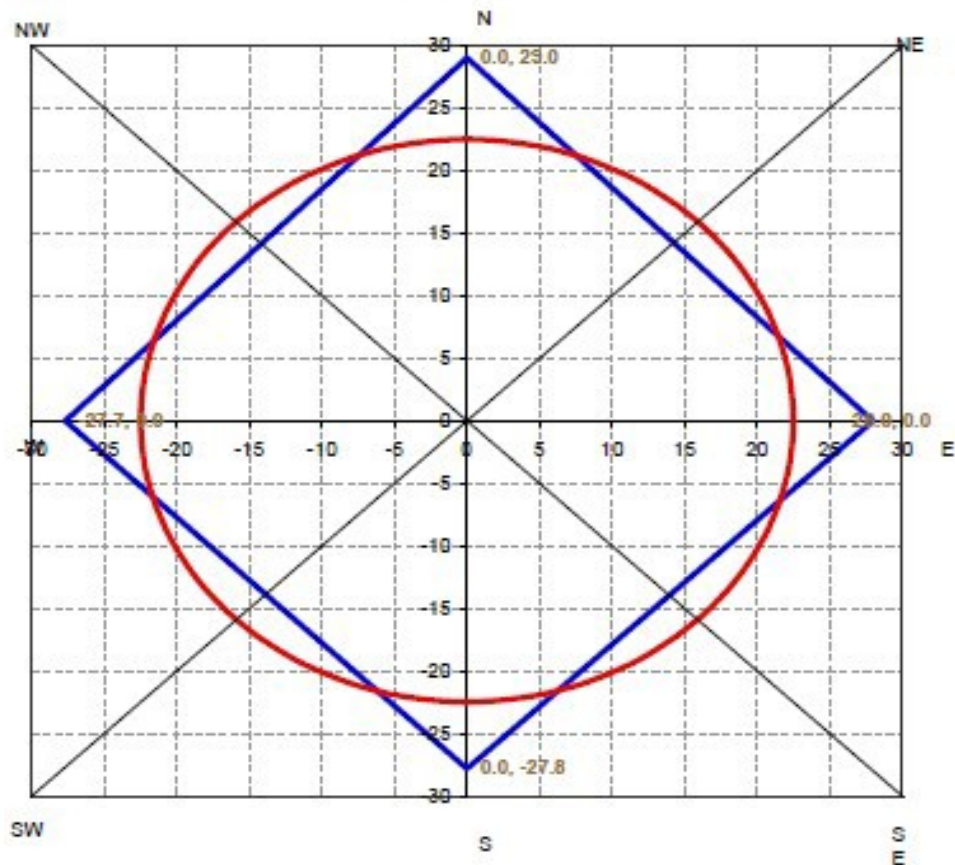
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-14**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-14
Co-ordinate : 785304E, 3117715N



Total Area of Polygon : 1584

Radius of Equivalent Circle=Mean Resistivity : 23 ohm-m

Polar Resistivity Curves (ERT-14)

Project No: 218024

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CLAUSE NO.



SCOPE AND SPECIAL TECHNICAL REQUIREMENTS



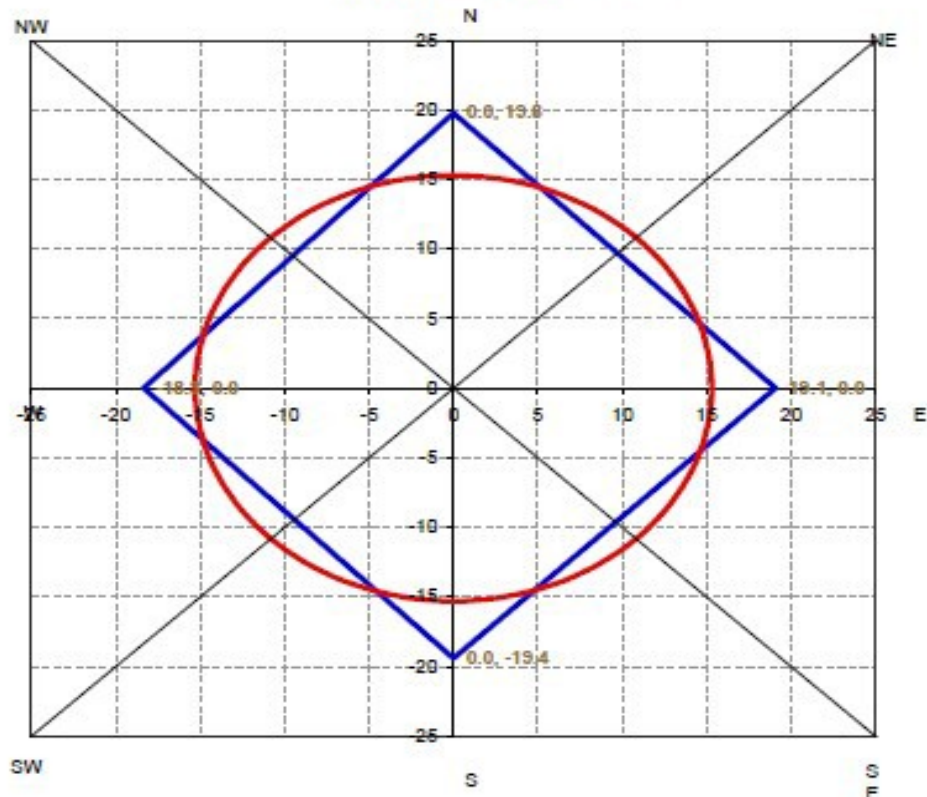
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Dist: Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

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**Electrical Resistivity Test No.: ERT-15**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-15
Co-ordinate : 785238E, 3118282N



Total Area of Polygon : 733

Radius of Equivalent Circle-Mean Resistivity : 15 ohm-m

Polar Resistivity Curves (ERT-15)

Project No. 218024

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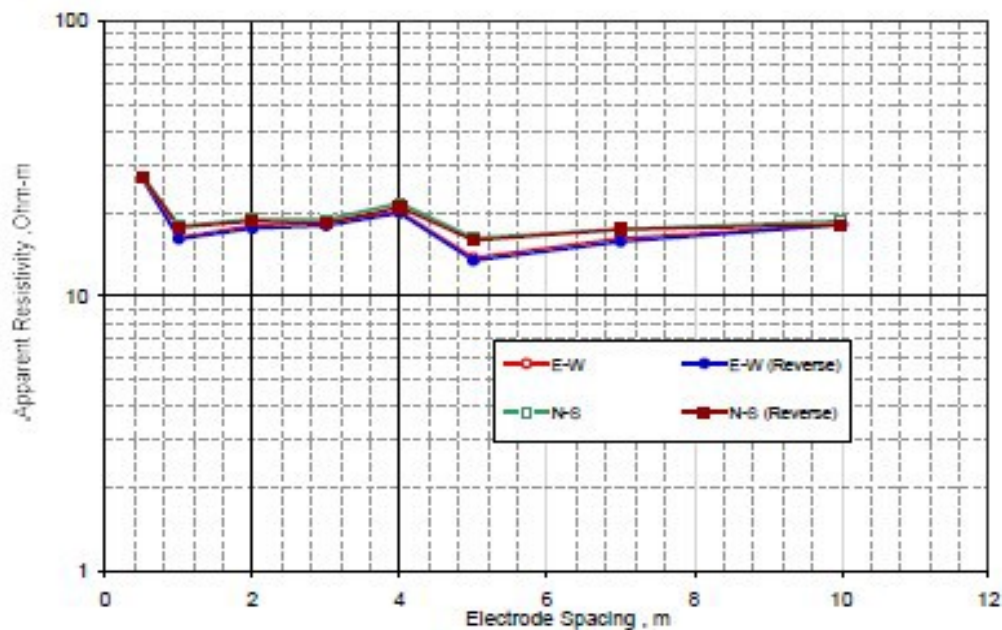
Geotechnical Investigation for 2X660 MW Khurja Super Thermal Power Project at Khurja, Distt. Bulandshahr, Uttar Pradesh
M/s. THDC India Limited

CENGRS

**Electrical Resistivity Test No.: ERT-15**

IS: 3043-1987, RA-2006

Test Details
Test Designation : ERT-15
Co-ordinate : 785238E, 3118282N



Electrode Spacing, m	Apparent Resistivity, Ohm-m			
	E-W	E-W (Reverse)	N-S	N-S (Reverse)
0.5	27.1	27.0	27.3	27.2
1.0	16.4	16.2	18.0	17.8
2.0	18.1	17.7	19.1	18.8
3.0	18.7	18.1	19.0	18.5
4.0	20.4	20.1	21.9	21.1
5.0	13.8	13.5	16.3	16.0
7.0	16.3	15.8	17.6	17.6
10.0	18.2	18.2	18.8	18.2
Mean Resistivity	19	18	20	19

Mean Resistivity Value, ohm-m : 15.3 ohm-m

Apparent Resistivity Values (ERT-15)

Project No. 218024

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Clause No.		EXCAVATION AND FILLING		
		SECTION - 1 EXCAVATION AND FILLING		
1.00.00		GENERAL REQUIREMENT		
1.01.00		Content This section of the specification covers the technical requirements for excavation and filling for all types of work i.e., in and around structures, buildings, pipes, foundations, trenches, pits, drains, channels, ducts, forebay, underground facilities like tunnels, pump houses, sumps, sewers, manholes etc. It also covers additional lifts, carriage beyond the initial lead, excavation below water table, filling using selected excavated materials, selected borrowed material (soil, sand, stone aggregate, gravel, ash), handling, transportation, compaction and disposal of surplus spoils and / or stacking them properly as directed by the Engineer.		
1.02.0		Codes and Standards		
1.02.01		Some of the relevant Indian Standards, Acts and Codes (Latest Edition) are referred to here below: IS 383 : Specification for coarse and fine aggregates from natural sources for Concrete. IS 2720 : Methods of test for soils IS 3764 : Safety code for Excavation work. IS 4701 : Code of practice for earthwork on canals. IS 9759 : Guide lines for dewatering during construction. IS 10379 : Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.		
2.00.0		EXCAVATION		
2.01.00		Classification The earthwork shall be classified under the following categories and measured separately for each category:		
2.01.0		All Kind of Soils Generally, any strata, such as sand, gravel, loam, clay, mud, black cotton soil, moorum, shingle, river or nallah bed boulders, siding of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), lime concrete, mud concrete and their mixtures which for excavation yields to application of picks, showels, jumper, sacrifiers, ripper and other manual digging implements is classified as Soil.		
2.02.00		Clearing grass and vegetation		
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-B SECTION-1
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Clause No.	EXCAVATION AND FILLING			
	Excavation shall include removal of trees including roots & organic remains, vegetation, grass, bushes, shrubs, plants, poles, fences, etc. that are in the area to be excavated as well as beyond the excavation line so as to ensure safety of the excavated side slopes, and of men and equipment operating in the area.			
2.03.00	Levelling	Bottoms of excavation shall be cut sharp and true to line and level. Undercutting shall not be permitted. The bottom of excavation before reaching the required level shall be excavated carefully by such equipment or manually so that the founding strata is not disturbed and the required final level is in natural condition. In case of excavation in rock, the methodology of excavating the rock at founding level without disturbing the natural strata, shall be as advised by the specialized agency.		
2.04.00	Water other than Ground water (i.e., Surface water)	The Contractor shall control the ground in the vicinity of all excavations so that the surface of the ground will be properly sloped or dyked to prevent surface water from running into the excavated areas during construction. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs, drain, etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, waterproofing, testing, backfilling is completed. The Contractor shall remove all slush / muck from the excavated areas to keep the work area dry. Sludge pumps, if required, shall be employed by the Contractor for this purpose.		
2.05.00	Coffer dam, sheeting, shoring etc.	The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheeting, shoring, bracing, and maintaining suitable slopes draining etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer. The Contractor shall submit drawings to the Engineer, showing arrangements of bracing, sheeting or shoring etc. and details of proposed installation. The Contractor shall also furnish all supporting calculations as called for and shall not proceed until he has received written approval from the Engineer. However, the responsibility for adequacy of such bracing, sheeting, shoring etc, will rest with the Contractor, irrespective of any approval of the Engineer. For deep and huge excavations and any other excavation, if required by the Engineer, the Contractor shall submit for Engineer's approval "excavation scheme" showing the methodology to be adopted for excavation in order to maintain the stability of side slopes, means for ensuring safety of existing nearby facilities, dewatering arrangement as described in subsequent clause, etc. However, the Contractor shall be fully responsible for the scheme irrespective of any approvals granted. Benching shall be provided for deeper excavation wherever required.		
2.06.00	Trimming of Excavation bottom	Excavation for foundations shall be to the bottom of lean concrete as shown on drawings or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels, by		
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-B SECTION-1
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Clause No.		EXCAVATION AND FILLING			
		error, it shall be brought back to specified level by filling with concrete of nominal mix 1:3:6 (cement: coarse sand: 40mm down aggregates) for excavation in rock and by stone aggregate with interstices filled with sand for excavation in soil by the Contractor at his own cost including arranging of the cement.			
2.07.00	Stacking	The Contractor shall dispose of all materials arising from excavations from the vicinity of the work either by direct filling, or by stacking and subsequently filling or by ultimate disposal as directed by the Engineer. In no case the excavated soil shall be stacked within a distance of 1.50 m from the edge of excavation or one third (1 /3) of the excavation depth, whichever is more. Material to be kept for subsequently filling / backfilling shall be stacked at location (s) as directed by the Engineer.			
2.08.00	Dressing of Bottom of Excavation Pit				
2.08.01		Excavations which have been done by the contractor of this package, any outcrop or unevenness at the bottom of excavation, shall be dressed up to the required level either by manual chiseling or mechanical means as required vide clause 2.03.00, above. No separate measurement shall be done for this and the cost of the same to be included in the relevant item(s) of excavation.			
2.08.02		In case, where in excavations have been done by other agency of a separate package, and the contractor of this package is required to dress up the bottom of excavations, which is uneven or with outcrop. Dressing of bottom of such excavations shall be carried out by this contractor either by manual chiseling or mechanical means to the required level. In this case, chiseling shall be measured and paid separately as per the relevant item.			
3.00.00	LIFT				
3.01.00		The Contractor is required to excavate up to any depth as shown on the drawings or as directed by the Engineer.			
4.00.00	CARRIAGE				
4.01.00		The carriage of excavated material to disposal / stacking areas shall be as indicated by the Engineer. a) Excavated materials required for back filling shall be carried up to a lead of 1000 M and stacked, as per instructions of the Engineer. The excavated materials shall be carried by mechanical means. b) If directed by the Engineer, excavated material can be used directly for back filling purposes by pushing and spreading by mechanical means in layers as described in Clause 6.00.00. c) Surplus excavated material shall be disposed of beyond within the plant boundary as directed by the Engineer. The disposed of material shall be spread in layers having compacted thickness not exceeding 300mm, each layer shall be compacted to achieve the specified density and shall be graded to have the required slope at the disposal site as directed by the Engineer. Contractor shall transport the excavated materials by mechanical means only.			
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-B SECTION-1	Page 3 of 10

Clause No.		EXCAVATION AND FILLING			
5.00.00	EXCAVATION BELOW GROUND WATER TABLE				
5.01.00	Wherever Ground Water Table is met with during excavation, the Contractor shall immediately report this fact to the Engineer.				
5.02.00	The Contractor shall dewater and maintain dry working conditions by maintaining the water table at least 0.5m below the bottom of the excavation level by well-point dewatering or deep well dewatering or any other method. Contractor shall prepare the detailed scheme for dewatering in line with IS:9759 and submit the same to the Engineer for approval. The dewatering work shall be done as per approved scheme. He shall continue dewatering i.e., maintain dry working condition till excavation, concreting, curing, water proofing, back filling / filling, testing and all other operations included in the scope of work, which require dry condition in the area, are completed.				
6.00.0	FILLING AND BACKFILLING				
6.01.0	Using selected Excavated materials				
	Excavated selected materials to be used for backfilling / filling purposes shall have the prior written approval of the Engineer.				
6.01.01	Material				
	a) Selected excavated materials to be used for backfilling / filling purposes shall consist of soil, crushed stone, sand or other inorganic materials and they shall be clean and free from shingle, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substructure in any manner. All clods shall be suitably broken to small pieces. b) When the material is mostly rock boulders, these shall be crushed into pieces not larger than 200 mm size. Such material shall be used in back filling of areas / layer where the compaction of 85 % of original volume is specified.				
6.01.02	Filling / Back Filling operations				
	a) Filling / back filling shall begin only with the written approval of the Engineer. The areas identified for backfilling shall be cleared of all soft pockets, vegetation, bushes, slush all temporary shoring, timber, etc. Backfill materials shall not be dropped directly upon or against any structure or facility where there is danger of displacement or damage. b) Filling / back filling shall be accurately finished to line, slope, cross section and grade as shown on the drawings. Finished surface shall be free of irregularities and depressions. Filling / backfilling shall be compacted to the required degree of compaction and level as shown in drawing.				
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-B SECTION-1	Page 4 of 10

Clause No.		EXCAVATION AND FILLING			
		c) Fill / backfill adjacent to pipes shall be free of stones, concrete, etc. and shall be placed and compacted uniformly on both sides of the pipe and where practicable up to a minimum depth of 300mm over the top of pipes. While tamping around the pipes. Care shall be taken to avoid unequal pressure.			
6.01.03	Transportation	Selected excavated material will involve loading from the stock pile of excavated material including excavation of soil which may become hard due to lying in the stock pile for a period of time, for all lifts and lead up to 1000m, carriage and unloading.			
6.01.04	Watering and Compacting	a) All space between foundation (concrete or masonry) and the sides of excavation shall be filled to the specified level after making allowance for settlement. Fill shall be placed in horizontal layers not exceeding 300mm compacted thickness. However, higher layer thickness (up to 500 mm) can be adopted for compaction where special types of equipment like vibratory rollers are used and the required degree of compaction is achieved. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction / density as specified. The methods of compaction shall be subject to the approval of the Engineer. i) Only manual compaction shall be by flooding and ramming. The Contractor at his discretion may use the mechanical means. ii) Where compaction upto less than 85% standard proctor density is called for, such compaction shall be by mechanical means but the Contractor may be permitted to adopt manual means only if the Engineer finds that the desired compaction is achievable in the field. iii) Where compaction of 85% or more of standard proctor density is called for, it shall be by mechanical means only. Where access is possible, compaction shall be by 10 Tonne rollers smooth wheeled, sheep foot wobbly wheeled or vibratory roller as directed by the Engineer. Where access to the heavy roller is not possible, a smaller vibratory roller (drum width 500 mm to 1000 mm) and/or plate vibrator shall be used for compaction. Each layer shall be watered, rammed and compacted to the density / volume as specified in the schedule of items. iv) Where rock boulders, construction debris have been used for filling, it shall be compacted to minimum of 85% of original stack of material after filling the interstices with the selected excavated material. b) The degree of compaction of compacted fill in place will be verified by tests as the work progresses, and the Contractor shall conduct such tests as per the approved Field Quality Plan. If any test indicates that the compaction achieved is less than the specified, the Engineer may require all fill placed subsequent to the last successful test to be removed and re-compacted by			
KHURJA STPP, (2 x 660 MW) CW SYSTEM CIVIL WORKS PACKAGE		Bid Doc. No.: THDC/RKSH/CC- 9915-414	TECHNICAL SPECIFICATIONS	PART-B SECTION-1	Page 5 of 10

Clause No.		EXCAVATION AND FILLING		
	the Contractor. Compaction procedure shall be amended as necessary to obtain satisfactory results.			
6.01.05	Grading & Dressing After filling, the top surface shall be graded by dozer/grader to achieve the required slope/level and dressed by light rolling.			
6.02.0	Filling using selected Borrowed material			
6.02.01	Material a) For materials to be borrowed from pits / quarries, then it shall be the Contractor's responsibility for identification and arranging of such quarry areas, obtaining approval for their use from concerned authorities, the Contractor shall pay any levies, royalties, etc., that may have to be paid for utilisation of borrow areas. b) Ash may be used wherever required. Ash shall be excavated by the Contractor from the ash pond and brought to the site. c) Sand for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. d) Selected soil brought from borrow area shall be free from stone, boulders and other organic material. It shall be non-expansive type of soil free from presence of harmful chemical, salt, vegetation, etc. e) Stone / gravel used for filling shall be crushed hard stone of specified nominal size and shall be free from all types of organic materials. f) Moorum brought from borrow area shall be free from stone, boulders and other organic material.			
6.02.02	Filling Filling shall begin only after approval of the Engineer of the borrow area and the material to be used for filling.			
6.02.03	Transportation Selected borrowed material will involve excavation / quarrying, loading and carriage of such material for all leads and lifts, unloading etc.			
6.02.04	Watering & Compaction a) Filling, watering and compacting, dressing and consolidating of selected soil brought from borrow area shall be done in the same manner as specified for the filling using the selected excavated material. b) For compacting each sand layer, water shall be sprayed over it to flood it and it shall be kept flooded for 24 hours to ensure maximum compaction. Vibro- compactors shall also be used if necessary, to obtain the required degree of compaction. Any temporary works required to contain sand under flooded condition shall also be undertaken by the Contractor at his own cost. The surface of the consolidated sand shall be dressed to required levels and slope.			
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Clause No.		EXCAVATION AND FILLING	
		c) Filling with 63mm downgraded stone shall be done with 63 mm nominal size stone laid in 200 mm loose thick layers, interstices filled with properly graded material consisting of selected stone and sand / soil. Each layer shall be watered and roller compacted by giving at least 10 (Ten) passes to of 8 - 10 T roller to achieve the specified volume with respect to the original volume before the next layer is laid. d) Where clean stone fill is specified, it shall consist of clean selected stone metal of 40mm nominal size. It shall be laid in layers not exceeding 200mm and lightly tamped before the next layer is laid. No compaction shall be required for this type of stone filling. e) Fly ash / pond ash shall be compacted using vibratory roller or any other method approved by the Engineer. However, the top 500mm layer of the filling shall be with earth unless otherwise specified.	
6.02.05		Grading & Dressing After filling, the top surface shall be graded by dozer/grader to achieve the required slope/level and dressed by light rolling.	
7.00.00		SAMPLING TESTING AND QUALITY CONTROL	
7.01.00		Frequency of sampling, testing and quality assurance including the methods for conducting the tests acceptance criteria and construction tolerances shall be as given in Part `C' of this specification	
8.00.0		RATES AND MEASUREMENTS	
8.01.00		Rates This clause shall be read in conjunction with the clause for the unit rate given in Part-A of this specification. Unit rates shall include a) for any extra excavation done to maintain side slope from safety consideration etc., b) for extra backfilling, disposal etc. arising out of extra excavation beyond the payment line. c) Sheet piling, if adopted by the Contractor as per his excavation methodology or convenience, in areas other than those specified elsewhere in the specification.	
8.02.00		Measurements This clause shall be read in conjunction with the clause for the measurements given in Part-A of this specification.	
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Clause No.		EXCAVATION AND FILLING			
8.02.01	Excavation and Backfilling				
i)	The excavation quantity shall be measured in cubic metre (cu.m.) and shall be as measured based on the vertical cutting multiplied by the plan area. The plan area shall be worked out on the basis of lateral (horizontal) dimensions, which shall be lesser of (a) as measured actual excavation outline and (b) as mentioned below based on the depth of excavation, a. 0.3m on each side, outside structural concrete for depth up to 1.0m. b. 1.0m on each side, outside structural concrete for depth beyond 1.0m and up to 3.0m. c. 1.5m on each side, outside structural concrete for depth beyond 3.0m and up to 6.0m. d. 2.0m on each side, outside structural concrete for depth beyond 6.0m and up to 9.0m. e. 2.5m on each side, outside structural concrete for depth beyond 9.0m and up to 12m. f. 3.0m on each side, outside structural concrete for depth beyond 12m and up to 15m. g. 3.5m on each side, outside structural concrete for depth beyond 15m. In case, only PCC is done like CW pipe encasement or mass PCC of more than 150 mm is done (other than mud mat / lean concrete for foundations), the above measurements shall be taken each side outside PCC outer line instead of structural concrete as mentioned above				
ii)	For measurement purposes the sides shall be considered vertical with the lateral dimensions indicated above. Nothing extra would be payable for slope, etc. irrespective of whatever is provided.				
iii)	The limiting quantity will be calculated based on the vertical distance from the existing grade level to the bottom level of lean concrete as shown on drawing or actual depth excavated, whichever is less.				
iv)	For evaluating the quantity of excavation and filling in rock, the Engineer shall be intimated by the Contractor as soon as rock level is reached. The decision as to whether rock is met or not shall be that of the Engineer and his decision shall be final and binding on the Contractor. Rock levels shall be recorded jointly by the Contractor and the Engineer. Measurements for rock excavation shall be taken separately for each item of work defined under excavation in rock in the Schedule of Items.				
v)	Over excavation / over breaks in rock / soil done by the Contractor, shall not be measured for payment. Similarly, the 1:3:6 mix cement concrete / stone aggregate placed to make up the over excavation in rock / soil shall also not be measured for payment.				
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Clause No.		EXCAVATION AND FILLING	
		vi) The volume between overlapping payment lines (which may occur when foundations are closely spaced) shall be measured only once for payment. vii) The volume shall be generally measured only once for payment. However, the area once excavated and backfilled after the approval of the Engineer, if it requires, due to exigencies of work, re-excavation and back filling, then the same shall be done after the specific approval of the Engineer and measure for payment. viii) No separate measurement shall be done for back filling, as it is included under the item of excavation. ix) No separate measurement shall be done for dewatering, as it is included under the item of excavation. x) No separate measurement shall be done for dressing up of bottom of excavation done by the contractor himself. xi) No measurement or payment will be made for excavation from borrow pit or for clearing or grubbing or for any excavation required by the contractor for his temporary works. xii) Dressing done by chiseling of bottom of excavations, done by other agency, shall be measured in cubic meter (cu.m.).	
8.02.02	Lift	Lift shall be measured in metres as the vertical distance from the existing grade level to the level from which the wet / dry materials are excavated. The quantity for each range of lift shall be the quantity of materials excavated from within that range and measured as per excavation.	
8.02.03	Carriage of Excavated Materials	i) Lead shall be measured as the distance carried of the wet / dry materials from the centre of the area of excavation to the corresponding centre of the area of stack / fill / disposal area of this material. ii) For the purpose of calculation of lead, the excavation areas and disposal areas shall be divided into suitable blocks / areas of maximum dimensions of 50 m x 50 m or actual area of excavation / stack / disposal whichever is less. The distance between the centre of excavation area and corresponding stack/ fill / disposal areas shall be measured along the shortest possible haulage path and not necessarily the one actually taken. The decision of the Engineer in this regard shall be final and binding on the Contractor. iii) The quantity of materials to be considered for payment for carriage shall be the quantity of materials found surplus for disposal as per the mode of measurement for excavation and actually carried beyond the initial lead of 5 kms. iv) Quantity of stacked excavated materials required for backfilling, for additional lead of every 1 km beyond the initial lead of 1 km, shall be measured in cubic meter (cu.m.). Total volume of stacked excavated material shall be equal to the sum of the volume of material of each additional lead multiplied by the	
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increment of lead over the initial lead of 1 km. For example, if volumes of material stacked in the leads of beyond 1 to 2 km, beyond 2 to 3 km & beyond 3 to 4 Km are 50, 150 & 25 cu.m. respectively, then the total volume to be considered for measurement shall be = (2-1) x 50 + (3-1) x 150 + (4-1)x 25 = 425 cu.m. If 'x' is the rate quoted per Cu.M. of excavated material for additional lead of every 1Km, then amount to be paid is 425x.					
8.02.04 Filling Quantity of fill shall be in cubic metre and volume of fill shall be least of : i) Quantity of material actually filled, ii) Excavation Less the volume of structure, foundation, pipe etc. falling within the fill volume so determined. For stone filling, payment shall be for the compacted volume of stone filling. No separate payment shall be due for filling interstices with sand / moorum.					
9.00.0 PAYMENT SCHEDULE For Excavation & Backfilling (a) The contractor shall be entitled to a payment of 60% of the unit rate for the item of work of excavation and backfilling on completion of excavation and acceptance of the same by the Engineer. (b) Balance 40% of the unit rate for this item of work shall be made after completion of balance works required to complete the work as per specification and Schedule of Quantities.					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
SECTION-2 CAST-IN-SITU CONCRETE AND ALLIED WORKS					
1.00.00		GENERAL REQUIREMENTS			
1.01.00		Contents			
		The section covers the technical requirement for cast-in-situ concrete, pre-cast concrete, reinforcement, formwork, embedded parts, anchor fasteners, admixtures, grouting / underpinning, joints in concrete, water proofing, dismantling, etc., at all levels, for all types of work in all kinds of working conditions.			
1.02.0		Codes and Standards			
1.02.01		Some of the relevant applicable Indian Standards, Codes, etc. (Latest Edition) applicable to this section of the specification are listed below:			
		IS 383	Specification for Coarse and Fine Aggregates from natural sources for Concrete.		
		IS 432	Specification for Mild Steel and Medium Tensile Steel Bars and Hard drawn Steel Wire for Concrete Reinforcement.		
		IS 456	Code of Practice for Plain and Reinforced Concrete. IS		
		516	Method of Test for Strength of Concrete		
		IS 702	Specification for Industrial Bitumen		
		IS 1199	Methods of Sampling and Analysis of Concrete.		
		IS 1489 (Part I)	Specification for Portland-Pozzolana Cement - Fly Ash based		
		IS 1786	Specification for High Strength deformed Steel Bars and Wires for Concrete Reinforcement		
		IS 1791	Specification for Batch type Concrete mixers.		
		IS 1834	Hot applied sealing compound for joints in Concrete		
		IS 1838	Specification for Preformed fillers for expansion joints in Concrete pavements and structures (non-extruding and resilient type)		
		IS 2062	Steel for general structural purposes		
		IS 2386	Methods of Test of Aggregates for Concrete.		
		IS 2502	Code of Practice for bending and fixing of Bars for Concrete Reinforcement.		
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
		IS 2505 General Requirements for Concrete vibrators, immersion type. IS 2506 General Requirements for Concrete vibrators, screed boards type. IS 2571 Code of Practice for laying in-Situ Cement-Concrete flooring. IS 2645 Specification for Integral Cement Water proofing compounds. IS 2750 Specification for Steel scaffoldings IS 2751 Code of Practice for welding of Mild Steel Plain and deformed Bars for Reinforced Concrete construction. IS 3370 Code of Practice for Concrete structures for the storage of liquids. IS 3414 Code of Practice for design and installation of joints in buildings. IS 3696 Safety code for scaffolds and ladders. IS 3812 Specification for fly Ash for use as Pozzolana and Admixture. IS 4014 Code of Practice for Steel tubular scaffolding. IS 4031 Methods for physical Tests for hydraulic Cement. IS 4082 Recommendation on stacking and storage of construction materials and components at site. IS 4130 Safety Code for demolition of buildings. IS 4326 Code of Practice for earthquake resistant design and construction of buildings. IS 4656 Specification for form vibrators for Concrete. IS 4925 Specification for Concrete Batching and mixing plant. IS 4926 Specification for ready-mixed Concrete. IS 4990 Specification for plywood for Concrete shuttering Work. IS 5121 Safety code for piling and other deep foundations. IS 5256 Code of Practice for sealing joints in Concrete lining on canals. IS 5525 Recommendations for detailing of Reinforcement in Reinforced Concrete Work. IS 5892 Concrete transit mixer and agitators. IS 6461 Glossary of terms relating to Cement Concrete. IS 6494 Code of Practice for Water Proofing of underground Water reservoirs and swimming pools. IS 6509 Code of Practice for installation of joints in Concrete pavements. IS 7293 Safety code for Working with construction machinery. IS 7861 Code of Practice for extreme weather concreting IS 8112 Specification for 43 grade Ordinary Portland Cement. IS 9103 Specification for Admixtures for Concrete. IS 9417 Recommendations for welding cold-Worked Steel Bars for Reinforced Concrete construction.			
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS		
	IS 9595	Recommendations for metal-arc welding of carbon and carbon manganese Steels.		
	IS 11384	Code of Practice for composite construction in Structural Steel and Concrete.		
	IS 11817	Classification of joints in buildings for accommodation of dimensional deviation during construction		
	IS 12118	Specification for two-Parts ploy sulphide.		
	IS 12200	Code of Practice for provision of Water stops at transverse contraction joints in masonry and Concrete dams.		
	IS 13311	Non-destructive Testing of Concrete.		
	IS 13920	Code of Practice for ductile detailing of Reinforced Concrete structures subjected to Seismic forces.		
	IS 14687	Guidelines for false Work for Concrete structure.		
	SP 7	National Building Code - Structural Design of Pre-Fabrication and system building. (Part 6 / Sec.7)		
2.00.0		CAST-IN-SITU CONCRETE		
2.01.0		General Requirement		
2.01.01		This part of the specification covers the requirements for plain and or reinforced cement concrete for all kinds of work such as building up of piles, pile cap, foundations including machine foundations, pedestals, columns, beams, slabs, lintels, floors, roofs, parapets, fascia, flooring, under bed, screed concreting, concreting over metal decking, encasement of structures, area paving, trenches, drains, pits, sumps, rigid foundation for rail-tracks, manholes, culverts, walls, tanks, coping, jambs, waist slabs, soffits of stairs, risers, treads, canopy, portico, grid slab, decks supported on vibration isolation system, basement, cable vault, etc.		
2.01.02		The provisions of IS 456 shall be followed as general guidance, along with all other relevant Indian Standards, unless otherwise specifically mentioned. Contractor shall deploy mechanised system for production, transportation and placement of concrete. At least one week before commencing the construction of any large concrete section, the Contractor shall submit, for approval of the Engineer, detailed proposals for placing the concrete to demonstrate the suitability of the methods.		
2.02.0		Materials		
2.02.01		Cement		
		Fly ash based portland pozzolana cement conforming to IS: 1489 (Part-1) shall be used for all areas. Other properties shall be as per IS code. In place of fly ash based portland pozzolana cement, OPC (grade-43 conforming to IS 8112) mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS: 3812 (Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.		
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS																	
a) Storage Immediately upon receipt at the site of work, cement shall be stored in a dry weather tight and properly ventilated structure with adequate provisions for the prevention of absorption of moisture All storage facilities shall be duly approved by EIC. Adequate capacity of storage shall be provided at each work site to ensure uninterrupted working. In order that cement may not become unduly aged after delivery, the contractor shall use any cement which has been stored at the site for 90 days or more before using cement of lesser age. Any cement stored at site for over 90 days shall not be used unless retest proves it to be satisfactory. b) Testing & Sampling Sampling and Testing of cement shall be done in accordance with relevant Indian Standard Specifications																			
2.02.02 Aggregates a) Coarse Aggregate Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. Quality, Grading, Sampling & Testing and Storage Manufactured Coarse aggregates shall consist of crushed stone which is produced by artificial crushing. Coarse aggregates as, delivered at batching plant shall have uniform and stable moisture content. The aggregate shall not contain harmful organic impurities (tested in accordance with IS:2386-Part III Latest edition) in greater percentage than specified by relevant IS Codes to affect adversely the strength or durability of concrete. Coarse aggregates may be rejected if it does not comply to the following requirements as specified in IS:2386 Latest edition <table><tr><td>Property</td><td></td></tr><tr><td>Crushing Value</td><td>shall not exceed 30% for wearing surface and 45% for other/non-wearing surface</td></tr><tr><td>Impact Value</td><td>shall not exceed 45% for wearing surface and 30% for other/non-wearing surface</td></tr><tr><td>Abrasion Value</td><td>for wearing surface =30% for other/non-wearing surface=50%</td></tr><tr><td>Soundness</td><td>Av loss after 5 cycle shall not exceed 12% when tested with sodium sulphate and18% when tested with Magnesium Sulphate</td></tr><tr><td>Specific Gravity</td><td>Not less than 2.60</td></tr><tr><td>Absorption Test</td><td>Should not exceed 5%</td></tr></table>						Property		Crushing Value	shall not exceed 30% for wearing surface and 45% for other/non-wearing surface	Impact Value	shall not exceed 45% for wearing surface and 30% for other/non-wearing surface	Abrasion Value	for wearing surface =30% for other/non-wearing surface=50%	Soundness	Av loss after 5 cycle shall not exceed 12% when tested with sodium sulphate and18% when tested with Magnesium Sulphate	Specific Gravity	Not less than 2.60	Absorption Test	Should not exceed 5%
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
The Coarse aggregates as batched shall be well graded and when tested by means of standard sieves, it shall confirm to IS 383 Latest edition. All sampling and testing of coarse aggregates shall be in accordance with the applicable provisions of IS 383 Latest edition and IS 2386 Latest edition. All test shall be made by the contractor under the supervision of Owner and expenses shall be borne by the contractor. Routine testing of CA at various stages in Aggregate Processing Plant, Storage Piles, and Batching & Mixing plant will be made by contractor under supervision of Owner. The contractor shall provide all such facilities as the EIC may consider necessary. The CA shall be stored in separate stock piles. The stock piles shall be built up horizontal or gently sloping layers. Trucks and the heavy machines shall be kept off the piles to prevent breakage and impairing the cleanness of aggregates. A hard base shall be provided to prevent contamination from under lying material in storage areas in continuous use. Sufficient storage of all grades shall be maintained.at work site Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory (as per ASTM C227) to ascertain the structure and rock type including presence of strained quartz and other reactive minerals for machine foundations, etc. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed. The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results are not satisfactory, shall be submitted to the Engineer for his review, in a report form. In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of TGs', BFPs' and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
b) Fine Aggregate Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116. However use of aggregate derived from Construction and Demolition waste or Recycled Concrete Aggregate shall not be permitted. Quality, Grading, Sampling, Testing and Storage Fine aggregates from approved source shall consists of siliceous material having hard, strong, durable, uncoated particles, free from injurious amount of dust, lumps, soft, flaky & elongated particles, shale, alkali, organic matter, loam, mica, and other deleterious materials. The manufactured sand shall also have the characteristics as the natural sand. The aggregate shall not contain harmful organic impurities (tested in accordance with IS:2386-Part III Latest edition) in greater percentage than specified by relevant IS Codes to affect adversely the strength or durability of concrete. The sand as batched shall be well graded and when tested by means of standard sieves, it shall confirm to IS 383 Latest edition. FM of Fine aggregate shall be greater 2.30 and less than 3.10 unless otherwise permitted by EIC. Use of blended sand (with natural sand) may be permitted and the FM of which shall be within the limits specified above. All sampling and testing of fine aggregates shall be in accordance with the applicable provisions of IS 383 Latest edition and IS 2386 Latest edition. All test shall be made by the contractor under the supervision of Owner and expenses shall be borne by the contractor. Routine testing of FA at various stages in Aggregate Processing Plant, Storage Piles, and Batching & Mixing plant will be made by contractor under supervision of Owner. The contractor shall provide all such facilities as the EIC may consider necessary. The Fine aggregate shall be stored in separate stock piles. The removal of materials from storage area shall be done in a manner to maintain the uniformity of the grading in so far as possible. All aggregates shall remain in free draining storage for at least 3 days prior to use. Sufficient live storage so as to least for the work without replenishment for at least one week shall be maintained. Arrangement may be made to store in a way that would protect from being contaminated from dust, organic matter or other deleterious substances.					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
2.02.03 Pozzolanas (Fly Ash)					
Fly ash for use in concrete and allied works shall conform to Grade-1 of IS 3812. The fly ash shall be collected in closed container from below the existing ESP / Dry Fly Ash Silos and tested for Blaine’s fineness (value should be more than 3200 sq.cm./ gm.). Mixing of fly ash for making concrete shall be done in proportion as per the mix design.					
2.02.04 Water					
Water used for mixing and curing shall be as per clause 5.4 of IS 456					
If the water proposed to be used for mixing in concrete or curing does not satisfy the codal requirements and / or contains an excess of acid, alkali, sugar, salt or other deleterious substances, then the same shall not be used.					
Seawater shall not be used for mixing in concrete and for curing.					
2.02.05 Admixtures (super plasticizer)					
Admixtures in concrete for promoting workability, retarding setting, reduction in permeability, facilitating pumping of concrete, etc., shall be used as per the approved mix design after approval from the Engineer. Admixtures shall conform to clause 5.5 of IS 456. These shall be free from injurious amount of chloride, etc. Addition of admixtures should not reduce the specified strength or durability of concrete and should not have detrimental effect on reinforcement.					
The following admixtures shall conform to IS 9103 or ASTM C-494 and shall be proven performance record make and from a reputed manufacturer. Calcium chloride as accelerating admixture is not permitted to be used.					
i) Accelerating Admixture ii) Retarding admixture iii) Water reducing admixture iv) High Range Water reducing admixture (Super Plasticizer) v) Water reducing & accelerating admixture vi) Water reducing high range (Super Plasticizer) & Retarder admixture vii) Air Entraining Admixture					
Admixtures shall either be naphthalene based or any other material approved by the Engineer. Lignosulphonate based materials shall not be used. Admixtures shall be used in liquid form only, quantity of which shall be as per manufacturer's recommendation and approved mix design.					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
2.03.0 Concrete					
2.03.01 Grades of Concrete					
Grade of concrete shall be as per schedule of Items and construction drawings All concrete shall be "Design Mix Concrete" as defined in IS 456, except for plain cement concrete of grade M-7.5 and M-10 which shall be nominal mix concrete. Concrete of grade M-15 can be nominal mix or design mix.					
2.03.02 Types of Mix					
2.03.03 Nominal mix Concrete					
Nominal mix concrete shall conform to clause 9.3 of IS 456. Proportions for nominal mix concrete shall be as per table 9 of IS 456.					
The maximum size of coarse aggregate in concrete for any part of the work shall be the largest of the specified sizes, the use is practicable from the stand point of satisfactory consolidation of the concrete by vibration except where it is determined that due to closely spaced reinforcement or for other reasons, the use of a smaller maximum size aggregate is necessary to obtain satisfactory placement of the concrete.					
2.03.04 Design Mix Concrete					
i) Contractor shall get the initial concrete mix design done from established laboratory such as National Council for Cement and Building Materials, National Test House, CSMRS New Delhi, Shri Ram Test House, Central Building Research Institute, Roorkee. The mix design shall be done considering various combinations starting with minimum cement contents as per IS 456 for the respective grade, with or without super plasticizer for different slumps suitable for pumping and with varying percentage of fly ash mix with cement viz., 0%, 10%, 15%, and 20%. ii) The concrete mix shall be designed for all grades of concrete to obtain the required workability and the characteristic strength as per clause 9.2 of IS 456. iii) In batching concrete, the quantity of cement, aggregates and admixtures shall be determined by mass. Water shall be either measured by volume in calibrated tanks or weighed. All measuring equipment at site, shall be maintained in a clean and serviceable condition, and their accuracy shall conform to requirement of clause 10.2.2 of IS 456 and shall be periodically checked. iv) To increase the workability and to improve other properties of concrete, wherever required, as per mix design, super-plasticizers shall be used. v) Minimum cement content and maximum free water-cement ratio for various grades of concrete shall be as per Table-5 of IS 456 latest edition corresponding to the respective grade and exposure condition. vi) Adjustments to minimum cement content for aggregates other than 20 mm nominal size shall be as per Table-6 of IS 456 latest edition.					
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vii) At least four trial mixes are to be made for each grade of concrete and minimum six test cubes taken for each trial mix noting the slump for each mix. The cubes shall then be properly cured and three cubes for each mix shall be tested at 7 days and others at 28 days for obtaining the compressive strength. The design mix particulars shall indicate with the help of graphs and curves etc. the extent of variation in the grading of aggregates, which can be allowed. While designing mixes, over wet mixes shall be avoided. Where assessment of early strength is required, the concrete cubes shall also be tested for early age strength at 1 day and 3 days for establishing the values. viii) The contractor shall submit the test reports of mix design to the Engineer for his review, indicating design criteria, analysis and proportioning of materials, etc. On the basis of the above test reports, a mix proportion by mass and the water-cement ratio, shall be determined by the contractor such that concrete prepared with this mix will yield the desired characteristic strength and shall have suitable workability. The proportions, once decided for different grades of concrete, shall be adhered to, during all concreting operations as long as the quality of the materials does not change. If, however, at any time, the quality of materials being used has changed from those for initial mix design, or there is a change either in the required strength of concrete, or water- cement ratio or workability, the contractor shall have to make similar trial mixes and perform initial tests to ascertain the revised mix proportions and water-cement ratio to be used for obtaining the desired strength and consistency. ix) In the situations, like casting of piles, where the compaction of concrete is not possible by vibration, the method of compacting concrete cubes of preliminary / trial mixes and work tests shall be in the same manner as the method of compacting concrete at site is proposed. 2.03.05 Workability of Concrete The concrete shall be of adequate workability suitable for the placing conditions of concrete. The suggested ranges of values of workability of concrete measured in accordance with IS 1199 shall be as per clause no. 7 of IS 456. 2.03.06 Mixing of Concrete a) All structural (Reinforced) concrete mixing shall be done at central batching plants, conforming to IS 4925, situated within the area allocated to the contractor. Batching Plant shall also have provision to mix fly ash (by weight). The batching plant shall have a mechanically operated mixer of an approved size and type, capable of ensuring a uniform distribution of the materials throughout the mass as well as uniformity of the colour and consistency of the mass. Digitised recording of the material consumed along with the quantity of concrete produced for every shift of eight hours shall be submitted to the Engineer. b) However, for PCC work of M-7.5, M-10 and M-15 Engineer may permit the use of independent mechanical mixer with weigh batching machine.			
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		c) At the batching plant, standard carted test weight shall be provided and such other auxiliary equipment as many be necessary to check to check the operating performance of each scale or there measuring device. when required by the Owner, operator shall make these tests in his presence. Unless otherwise required by the owner check tests of equipment used for measuring water, cement, aggregates and admixture shall be made at least every week. d) Measuring Tolerances Batching equipment shall be constructed and operated so that the combined inaccuracies in feeding and measuring the material do not exceed the following tolerances according to IS :456 Latest Edition • ±1% of the quantity of cement /additives being measured • ±2% for each size of aggregates • ±1% of the total mixing water • ±3% of the quantity of chemical admixtures Weighing Equipment The quality of the equipment and its practical use shall satisfy the following tolerance in % by weights of the components: • Cement ±1% • Coarse & Fine Aggregates ±2% • Additives ±1% for each addition • Mixing water ±1% • For admixture ,the tolerance is ±3% bt volume Volumetric Batching Volumetric batching shall not be resorted to without prior permission of EIC who may allow this at the sole discretion when the quantity of concrete work and the rates of its placement are so small as not to warrant the use of complete weight batching equipment. When it is considered necessary to resort to volumetric batching instead of weigh batching it shall be subject to the specific approval of the EIC. The quantity of Fine & Coarse aggregate shall be specified in volumetric unit based on bulk density of Fine & Coarse aggregate determined from time to time when the concreting is in progress. The cement shall always be weigh batched. For the purpose of check and control, all the batches of concrete, in case of volumetric batching shall be proportioned on the basis of 50 kg of cement. After weighing of each bag the adjustment in weight shall be made by adding cement to it to weigh 50 kg of cement after such adjustment. The necessary arrangements shall be made to batch the aggregates to an accuracy to the nearest 0.008 cum by gauge boxes of suitable sizes provided in sufficient numbers separately for fine and coarse aggregates. If there is no provisions of a water tank and an equipment for measuring water, measure to get Ten, Five, Two and One liter of water shall be provided at the mixture.		
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
2.03.07	Concrete Conveying Concrete shall be handled and conveyed as rapidly as practicable, from the place of mixing to the place of final laying, by transit mixers to maintain the consistency of the mix. However, where use of independent mechanical mixer is permitted by Engineer, conveying of concrete can be by means other than transit mixer.				
2.03.08	Concrete Placing and Compaction a) General placement of all reinforced (structural) concrete shall be by boom placer or by pumping. Placement of concrete in piles shall be through tremie pipe fed by pumping. However, placement of non-structural concrete (PCC) such as in flooring, plain / lean concreting, etc. can be by either pumping or other means as approved by Engineer. b) Concrete shall not be dropped from a height or handled in a manner, which may cause segregation. The maximum permissible free fall of concrete shall be 1.5 m. c) For concrete placed by boom-placer/pumping, the consistency shall be the minimum necessary for such conveyance of concrete. Before commencement of regular pumping, the pipeline shall be lubricated with cement mortar and once pumping commences, stoppages shall be avoided. d) When concreting around the pipes, the contractor shall make sure that the steel lining does not move during concreting. e) Concrete shall not be placed in foundations on soft areas or where there is standing water or debris. Such soft areas shall be removed and standing water / debris cleared before placing the concrete. f) Concrete shall be placed continuously in horizontal layers of 150mm or higher thickness as directed by the Engineer and thoroughly compacted before placing next layer. The thickness of each layer shall be such that it will be deposited before the previous layer has stiffened. When placing the concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregates. g) Concrete shall normally be poured in one operation. In special circumstances, with the approval of the Engineer, it can be poured in more than one operation subject to provision of construction joint. Bleeding of under layer, if any, shall be effectively removed. h) Compaction of concrete shall conform to Clause 13.3 of IS 456. i) Surface vibrators and form-attached vibrators shall not be permitted under normal conditions. Their use shall require written approval of the Engineer. j) Vibrators shall penetrate both the layer poured and the under layer to ensure good bond and homogeneity and to prevent the formation of cold joints. Immersion vibrators shall not be allowed to come in contact with steel reinforcement after start of initial set. Also, they shall not be allowed to come in contact with forms or finished surfaces. k) Immersion vibrators shall have a 'no load' frequency, amplitude and acceleration as per IS 2505 depending upon the size of the vibrator. Immersion vibrators shall be operated by experienced men. These vibrators shall be immersed not more than 450mm apart and withdrawn when air bubbles cease to come to the surface. Such vibrators shall in no case be used to push concrete inside the forms and vibrators shall be withdrawn slowly.				
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Clause No.	NTPC	CAST-IN-SITU CONCRETE AND ALLIED WORKS	
		No concrete shall be placed in wet weather or on a water-covered surface. If there have been any signs of washing of cement or sand, the concrete shall be entirely removed immediately. Suitable precautions shall be taken in advance to guard against possible rains before leaving the fresh concrete unattended. l) Concrete in works other than top decks of machine foundations, when placed, shall have a temperature of not less than 5 degree centigrade and not more than 40 degree centigrade. When depositing concrete in very hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 40 degree centigrade while placing. This shall be achieved by stacking aggregates under the shade and keeping them moist, using cold water, starting curing before concrete dries out, etc. However, before mixing / placing concrete, when the above temperature conditions vary on either side, approval of the Engineer shall be obtained for the method of execution. m) During hot weather (atmospheric temperature above 40 degree centigrade) or cold weather (atmospheric temp at 5 degree centigrade and below) the concreting shall be done as per the procedures and Precautions set out in IS 7861 (Parts I and II). n) Base raft of turbo-generator and other machine foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint. Sampling of Fresh Concrete As far as possible, samples shall be taken from the vibration concrete in forms. The minimum frequency of the sampling of concrete of each grade shall be as specified in IS 456. At least one sample shall be taken from each shift. Sampling from chutes, conveyors transporting containers etc., whenever unavoidable, will be vibrated in the Moulds to stimulate the vibrations given in the forms. Separate portions of the samples shall be used for slump, unit weight and casting of cubes for strength. Slump test/unit weight and air content tests and casting of cubes specimens shall be made without delay after sampling, as a delay of even 15 minutes may decrease the slump as much as 50%.	
2.03.09		Protection and Curing of Concrete	
		a) Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below ground level, shall be protected from falling earth, during and after placing. Concrete placed in ground containing any deleterious substances, shall be kept free from contact with such ground or with water draining from such ground, during placing of Concrete and for a period of at least three days or as otherwise instructed by the Engineer. b) The ground water around newly poured concrete shall be kept down to an approved level by pumping or other approved means of drainage. Adequate steps shall be taken to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete. c) Curing shall be as per Clause 13.5 of IS 456.	
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
2.03.10 Cleaning and finishing of Concrete					
a) All concrete surfaces shall have an even and clean finish free from honeycombs, air bubbles, fins or other blemishes, unmarred and reasonably smooth. The formwork joint marks on concrete work exposed to view including machine foundations of TGs', BFs', Fans & Mills shall be rubbed with carborandum stone. The finish shall be made to the satisfaction of the Engineer. Concrete surfaces to be subsequently plastered or where brick work is to be built against them, shall be adequately hacked as soon as the form is stripped off so that proper bond can develop.					
b) Immediately after removal of forms, the concrete shall be inspected and defective areas as pointed out by the Engineer shall be removed partially or entirely as directed. Holes, left by form bolts, etc. shall be filled up and made good with cement sand mortar of approved mix. All superficial defects such as honeycombing, rough patches, etc. shall be similarly made good. If the defective area is at a vulnerable location, e.g., at the ends of beams & columns, etc. then it may be necessary to cut out the member completely or in part and reconstruct as directed by the Engineer. If epoxies have to be used, the same shall be subject to the approval of the Engineer. Poured concrete affected by faulty formwork shall be totally removed and replaced. If so directed, the contractor shall have to resort to grouting.					
c) A smooth finish shall be obtained with the use of forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothened off and all blemishes, projections etc. removed leaving the surfaces reasonably smooth and unmarred.					
d) Where integral cement concrete finish is called for, the surface shall be compacted and then floated and treated with a straight edge and any high and low spots eliminated. The work shall be carried out as per IS 2571.					
2.03.11 Rendering					
The defect in concrete surfaces shall be rendered by 1: 3 (cement: sand) mortar to give an even and clean finish to the concrete surfaces.					
2.03.12 Rectification of defects in concreting observed by UPV Testing					
Defects in concreting including cavities / voids, honeycombing in concrete, observed by UPV testing need to be rectified by cement / epoxy grouting or a combination of both without any additional cost to owner.					
a) Cement grout - cement grouting shall be done in structures / foundations where large-scale voids or honeycombing are observed. The cement grout with non-shrink admixture and or plasticizer shall be used. Water cement ratio needs to be controlled and it shall be preferably less than 0.5. Nipples shall be fixed in the locations where grouting has to be carried out. Cement grout shall be injected at a pressure of 2.5 to 3.0 kg / Sq. Cm.					
b) Epoxy grout - epoxy grouting shall be carried out in critical locations from serviceability as well as structural point of view. In addition, this shall be carried out in locations where narrow passage is available for free flow of grout. The proportion of resin to hardener shall generally be 100: 30. However, the actual proportion shall be as per manufacturer's recommendations. The epoxy system shall be non-shrink, low viscosity and free flowing. The epoxy grout shall be injected at a pressure of 3.0 to 4.0 kg / Sq. Cm.					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS	
2.04.00		Temperature Control of Concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans, etc.) The temperature of fresh concrete shall not exceed 25°C when placed and a suitable measuring device / gauge for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of 25°C, ice shall be used in mixing water. The contractor shall establish the quantity of ice to be mixed in order to achieve the limiting temperature of 25°C. In addition to mixing of ice, other methods for control of temperature like cooling of aggregates may also be resorted to.	
2.05.00		Admixtures (super plasticizer) Admixtures in concrete for promoting workability, retarding setting, reduction in permeability, facilitating pumping of concrete, etc., shall be used as per the approved mix design after approval from the Engineer. Admixtures shall conform to clause 5.5 of IS 456. These shall be free from injurious amount of chloride, etc. Addition of admixtures should not reduce the specified strength or durability of concrete and should not have detrimental effect on reinforcement. The admixtures shall conform to IS 9103 or ASTM C-494 and shall be proven performance record make and from a reputed manufacturer. Calcium chloride as accelerating admixture is not permitted to be used. Admixtures shall either be naphthalene based or any other material approved by the Engineer. Ligno-sulphonate based materials shall not be used. Admixtures shall be used in liquid form only, quantity of which shall be as per manufacturer's recommendation and approved mix design.	
2.06.0 Construction Joints			
2.06.01		Construction joints shall conform to clause 13.4 of IS 456 latest edition. However, for water retaining structures, provision of IS 3370 latest edition shall also be followed.	
2.06.02		When work has to be interrupted, the concrete shall be rebated and / or keyed at the joint to such shape and size as may be required by the Engineer or as shown on the drawings. All vertical construction joints shall be made with stop boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. In the case of water retaining structures, basements, tunnels, etc. water stop of approved material shall be provided, if so specified on the drawings or as directed by the Engineer.	
2.06.03		Construction joints shall be located as shown or described on the drawings. Where it is not described, the joints shall be in accordance with the following guidelines: i) In a column, the joints shall be formed about 75mm below the lowest soffit of the beams framing into it, including haunches, if any. In flat slab construction, the joint shall be 75 mm below the soffit of the column capital. ii) Concrete in a beam shall be placed throughout without a joint. If unavoidable, the joint shall be vertical and within the middle-third of the span. The joints shall be vertical throughout the full thickness of the concrete member with suitable shear key wherever shown on the drawing.	
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS	
		iii) A joint in a suspended floor slab shall be vertical at one-quarter points of the span and at right angle to the principal reinforcement. iv) Construction joints in equipment foundations shall not be provided without specific concurrence of the Engineer. v) Construction joints in water retaining structures shall not be provided unless shown on the drawings or permitted by the Engineer. However, if the contractor desires any adjustments in the location of construction joints (to suit site conditions) from those shown on drawings or from those explained above, he shall obtain prior approval from the Engineer.	
2.06.04		Before fresh concrete is placed, the cement skin of the partially hardened concrete which was poured earlier, shall be thoroughly removed and the surface made rough and aggregate exposed, by wire brushing, hacking, water jetting, air jetting or any other method as directed by the Engineer. The rough surface shall be thoroughly wetted for about 1 / 2 hour and shall be dried and coated with 10 to 15mm thick layer of 1: 1 freshly mixed cement and sand slurry. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer.	
2.06.05		In forming a joint, concrete shall not be allowed to slope away to a thin edge. The locations of construction joints shall be planned by the contractor well in advance of pouring and they will have to be approved by the Engineer. The Contractor's proposals shall include the location of construction joints, the sequence of pouring, formwork details and their stripping times and any other relevant detail.	
2.06.06		For multiple lift work, a suitable gap shall be maintained between the setting of the earlier placed concrete and the next concrete pour. After depositing concrete in columns, piers or walls, a time gap of minimum 4 hours, preferably 24 hours shall be maintained, before depositing concrete in beams, girders or slabs, supported thereon, in order to avoid cracking due to settlement.	
2.07.00		Hot Applied Bitumen Treatment Where shown on the drawings or directed by the Engineer, the external plastered / unplastered concrete surface below ground shall be carefully cleaned, cured and allowed to dry for sometime before the application of hot Bitumen of the Industrial grade 85 / 25 conforming to IS 702 against ground water seepage. Rate of application of Bitumen shall not be less than 1.7 kg / m2 and it should be heated to about 120oC before application and shall be applied in minimum two coats. Anti- stripping compound shall be added. Anti-stripping and adhesion improving agent shall be 100% miscible in Bitumen. The stripping value tested as per IS 6241 should be nil when recommended quantity of anti-stripping compound is mixed. Minimum mix proportion of the anti-stripping compound shall be 1 percent by weight of Bitumen. However, actual mix proportion shall be as per the manufacturer's recommendation.	
3.00.00		REINFORCEMENT	
3.01.00		General Requirements	
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3.01.01	This part of the technical specification covers the requirement of reinforcement for all reinforced concrete works (cast-in-situ as well as pre cast) including piling.			
3.01.02	The contractor shall prepare and furnish to the Engineer, bar bending schedules for all R.C.C works for his review and approval. No work shall commence without the approval of bar bending schedules by the Engineer, in writing. The contractor shall have to obtain prior written approval from the Engineer, if he desires any adjustments in diameter or spacing of reinforcement.			
3.02.0	Reinforcement Steel			
3.02.01	Reinforcement steel shall be of high strength deformed TMT steel bars of grade Fe- 500/Fe 500D and shall conform to IS 1786. However, minimum elongation shall be 14.5%. Mild steel & medium tensile steel bars and hard drawn steel wire shall conform to grade A of IS 2062. Welded wire fabric shall conform to IS 1566.			
3.03.0	Bending and Placing			
3.03.01	a) This shall generally conform to clause No. 12 and 26 of IS 456. i) Reinforcing bars supplied bent or in coils, shall be straightened before these are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is to be considered as a part of reinforcement bending. ii) Unless otherwise specified, reinforcing steel shall be bent in accordance with procedure specified in IS 2502 and / or as approved by the Engineer. Unless specified otherwise or directed by the Engineer, the detailing of reinforcement shall be in accordance with IS 5525 and SP 34. iii) Welding of reinforcement, where permitted, shall be carried out as per IS 2751 and IS 9417 and according to the best practices. iv) Joint in steel bars of 25 mm diameter and above will be required to be welded for producing equal strength of bars, unless otherwise directed by EIC. the reinforcement bars, less than 25mm diameter, shall be overlapped equal to its development length in compression or tension, as the case may be, as specified in IS:456 Latest edition . v) In case of welding being done to join bars of different sizes, the length of lap shall be governed by the smaller size of bars and payment made for the same. vi) Bundled bars shall be provided wherever shown on the drawing to facilitate concreting. vii) The placing of reinforcement shall be completed well in advance of concrete pouring. Just prior to concrete pouring, the reinforcement shall be checked by the Engineer, for accuracy of placement and cleanliness. Necessary corrections as directed by the Engineer shall be carried out. Care shall be taken to ensure that projecting ends of ties and other embedded metal do not encroach into the concrete cover.			
3.04.00	Binding in Position Bars intended to be in contact at crossing points, shall be securely bound together at all such points by two numbers annealed steel wire of 0.9 mm to 1.6 mm size			
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		conforming to IS 280 in such a manner that they do not slip over each other at the time of fixing & concreting. The tying of bars shall be in criss-cross manner.	
3.05.00		Concrete Cover Blocks Where concrete blocks are used for ensuring the cover and positioning of reinforcement, these shall be made of mortar 1:2 (1 Cement: 2 sand) by volume and cured for at least seven days. The sizes and locations of the concrete blocks shall be approved by the Engineer. The 28 days crushing strength of cover blocks shall be at least equal to the specified strength of concrete in which the blocks will be embedded.	
3.06.00		Chairs and Spacers All reinforcement shall be accurately fixed and maintained in position as shown on the drawings by such approved means as steel chairs or spacers as per IS 2502. The vertical distance between successive layers of bars shall be maintained by providing chairs / spacer bars. These shall be so spaced that the main bars do not sag perceptively between adjacent chairs / spacers.	
3.07.00		Cover to Reinforcement This shall be as per Table 16 and Clause 26.4 of IS 456 considering moderate exposure for outdoor condition and mild exposure for indoor condition unless otherwise specified and / or shown on the drawings.	
3.08.00		Laps and Anchorage Laps and Anchorage length of reinforcing bars shall be in accordance with IS 456, unless otherwise specified. Location of laps and development lengths, shall be as indicated on the drawings. If the bars in a lap are not of the same diameter, the smaller diameter will guide the lap length. Laps shall be staggered as far as practicable and as directed by the Engineer and not more than 50% of bars shall be lapped at a particular section.	
4.00.0		FORM WORK	
4.01.0		General Requirements	
4.01.01		This part of the specification covers the requirements for providing and fixing form work and staging required for all cast-in-situ concrete works including making of pockets / block outs.	
4.01.02		The contractor shall supply, fabricate, erect and dismantle (after use) all staging whatsoever is required. He shall prepare the scheme and submit along with the supporting calculations for approval of the Engineer and get them approved before the start of work. Form work shall conform to IS 14687 - False Work for Concrete structures - Guidelines.	
4.01.03		Materials and accessories for false work (form work) shall conform to clause no. 6 of IS 14687.	
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS	
4.01.04		Staging, unless specified otherwise, shall generally be of mild steel tubes, steel beams and channels etc., and of modular construction.	
4.02.00		All formwork shall be formed using approved quality BWP type, compreg (densified) plywood with suitable overlay (film faced) and conforming to IS 3513 Part-III and IS 4990 to produce a perfectly levelled, uniform and smooth surface. Reuse of such forms may be permitted only after inspection and approval by the Engineer, for each such reuse. Any damage to film face shall be caused for rejection. The faces of plywood with suitable overlay shall be dense, smooth and without blisters and patch marks. It shall be of uniform colour. Film face shall have minimum 250 GSM (Grams/ Sq.M.) coating.	
		4.03.0 Form Work and Staging	
4.03.01		Form Work shall conform to clause no. 11 of IS 456. Form Work shall consist of all materials required for forming the boxing to pour concrete, including steel / plywood forms, ties, anchors, hangers, inserts, etc. Form Work shall be so constructed that vertical and horizontal adjustments can be made as required. The design and engineering of formwork including staging as well as its erection and dismantling shall be the responsibility of the contractor.	
4.03.02		The staging shall be true and rigid and thoroughly braced in both directions as well as cross braced, strutted and propped such that it will not deform unduly under weight of concrete and other loads due to men, equipment, etc. Vertical members or props should not be supported on an un-propped lower suspended floor or beam unless it is ensured by the Contractor that the lower floor or beam can safely carry the loads. No propping shall take place until the Engineer's approval has been given to the contractor's scheme submitted along with supporting calculations.	
4.03.03		The forms and staging shall be sufficiently strong to carry without undue deformation, the dead weight of green concrete as well as anticipated working loads. Where the concrete is vibrated, the form work shall be strong enough to withstand the effects of vibration, without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure a smooth, uniform surface, free from honeycombs, air bubbles, bulges, fins and other blemishes.	
4.03.04		To achieve the desired rigidity, ample studs, braces, bolts, spacer blocks, wires, clamps, ties, straps, shores, etc. shall be used to hold the form in proper position without undue distortion. These shall be approved by the Engineer but they must in no way impair the strength of concrete or leave stains or marks on the finished surface. Bolts passing completely through liquid and or earth retaining walls / slabs, basement walls etc. for the purpose of securing and aligning the form work, shall not be permitted.	
4.03.05		Beveled strips shall be provided to form angles and in corners of columns and beam boxes for chamfering of corners. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where these are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed rigidly when required and must not leave any mark on the concrete.	
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS		
4.04.00	Cambering	The contractor shall maintain necessary camber in centering for all floor slabs and beams in all spanning directions, so as to offset the deflection and assume correct shape.		
4.05.00	Cleaning	All forms shall be thoroughly cleaned of old concrete, dirt and dust sticking to them before these are fixed in position. All rubbish, loose concrete, chippings, etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Wire brushes, brooms, compressed air jet and / or water jet etc. shall be kept handy for cleaning. Before form work is placed in position, the form surfaces, that will be in contact with concrete shall be treated with form releasing agent (mould oil) as per clause no. 6.3 of IS : 14687. The mould oil shall be a solution of preservative in a heavy mineral oil with a viscosity of 70-80 centipoise. This shall be free from dark and other suspended particles and shall be of light gray colour.		
4.06.00	Design and Erection	The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls may be removed first, leaving the beam bottoms and their supports in position. Re-propping of beams shall not be done except with the approval of the Engineer. Formwork for columns and walls at each stage of concreting shall be erected only upto the particular lift of construction. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jerking the concrete.		
4.07.0 Removal of Forms and Staging				
4.07.01	This shall generally conform to Clause No. 11.3 of IS 456 and 9.5 of IS 14687.			
4.07.02	The contractor shall remove formwork only after approval of the Engineer. He shall place on record the dates on which the concrete is placed in different parts of the work and the dates of removal of formwork therefrom. The contractor shall be responsible for the safe removal of formwork. The Engineer may delay the time of removal if he considers it necessary. Any work showing signs of damage through premature removal of formwork, shall be entirely removed and reconstructed by the contractor at no extra cost to the owner.			
4.07.03	In normal circumstances and where ordinary Portland Cement is used, forms may generally be removed after the expiry of the minimum periods specified in Clause No. 11.3 of IS 456 and 9.5 of IS 14687. In case of mixing of fly ash with OPC (Ordinary Portland Cement) and where fly ash-based Portland Pozzolana, Cement is used, the stripping time of formwork shall be suitably increased by Engineer based on the results of cube test on the rate of development of design strength. In absence of the above information the stripping time shall be increased by 50% more than that being adopted for OPC.			
4.07.04	The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.			
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4.07.05	Where the shape of the element is such that the formwork has reentrant angles, the formwork shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.			
4.07.06	In case of cantilever slabs, the removal of forms shall begin from the outer edge and proceed towards the support, where as in the case of slabs supported on two / four sides, the removal of forms shall begin from center to supports.			
4.07.07	The formwork declared unfit or unserviceable by Engineer shall not be used.			
5.00.0	EMBEDDED PARTS			
5.01.0	General Requirement			
5.01.01	This part of the technical specification covers the erection of embedded steel parts, providing and installation of mild steel / PVC pipes, providing and fixing of anchor fasteners, laying of rail tracks, etc.			
5.01.02	For fabrication and erection of insert at site, specification for structural steel work shall be referred to.			
5.01.03	Deleted			
5.01.04	Embedded steel parts shall include items such as, but not limited to, foundation grillages, anchor bolts, pipe sleeves, equipment mounting plates, steel pieces with / without lugs, auxiliary framing for equipment supports, miscellaneous frames, etc., deformed steel bars shall not be used for lugs.			
5.01.05	Concreting of the adjacent area of the embedded parts shall be done carefully to avoid displacement of the embedded parts and honeycombing / voids.			
5.02.00	Material Rolled steel and Structural steel shall conform to IS 2062. Mild Steel pipes shall conform to IS 1161. Unless otherwise specified, medium class pipes shall be provided. PVC pipes shall conform to IS 4985. Minimum pressure rating for PVC pipes shall be 2 kgf / cm2.			
5.03.0	Embedded Steel Parts			
5.03.01	The contractor shall transport to site and erect accurately in position all embedded steel parts including layout, welding, bolting and drilling. Exposed surfaces of embedded parts other than holding down bolts, are to be painted with primer painting with chlorinated rubber-based zinc phosphate.			
5.03.02	During erection, the contractor shall provide necessary strong temporary bracings and supports to ensure proper installation of the embedded parts which shall be erected at the true location as shown on the drawings and these shall be in plumb and level (unless otherwise shown on drawings).			
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5.04.0	Mild Steel / PVC pipes				
5.04.01	For fabrication and erection of the pipe embedment, specification for structural steel shall be referred to.				
5.04.02	IS 7634 (Part-III) shall be followed for PVC pipe Works.				
5.04.03	The pipes shall be installed accurately in position and if required, temporary supports shall be provided to ensure that these are not disturbed during concreting and other related works.				
6.00.0	GROUTING				
6.01.0	General Requirements				
6.01.01	This part of the specification covers the requirements of grouting of block outs, pockets, foundation bolt holes, and of spaces below the base plate and machine bases, etc.				
6.01.02	Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / Sq. mm, unless otherwise specified.				
6.01.03	The contact area between the grout and base plate shall not be less than 80%				
6.02.0	Materials				
6.02.01	Cement shall be Ordinary Portland Cement conforming to IS 8112.				
6.02.02	Sand shall be clean and well graded conforming to IS 383. For fluid mix grout, sand conforming to zone-4 grade shall be used. Coarse aggregate wherever used shall also conform to IS 383.				
6.02.03	Clean potable water as recommended for concrete mix shall be used.				
6.02.04	Admixtures				
	a) Anti-shrinkage ready mix admixtures of approved make shall be used.				
	b) Plasticiser conforming to IS 9103 shall be used to increase the workability, wherever required.				
6.02.05	Types of Mix.				
	a) This shall be of following types.				
	i) Cement-Sand Grout (Fluid mix and / or plastic mix): The proportion of cement to sand shall generally be 1:2, unless otherwise specified.				
	ii) Cement aggregate grout (stiff mix): The approximate proportions of cement, sand and coarse aggregate shall be 1:1.25:2 by weight, with a maximum size of aggregate as 10 mm.				
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		This mix shall generally be used for grout thickness above 40 mm for dry pack application. b) Depending upon the case of placement and method of application there shall be following three grout consistencies. i) Fluid Mix: Water-Cement ratio shall be 0.6 (max.). Plasticiser shall be added to increase workability. This grout mix shall be suitable for application with low-pressure grouting equipment or self-flowing and suitable for grouting of pockets / blockouts, etc. ii) Plastic Mix: Water-Cement ratio shall be about 0.5. This grout mix shall be suitable for application with trowel or rod. iii) Stiff Mix: Water-cement ratio shall generally be 0.4. This grout mix shall be suitable for dry-pack application. The consistency should allow pressurising into firm hard ball without cracking.			
6.03.0 Surface Preparation					
6.03.01	The block outs, bolt holes, underside of the base plate, concrete surfaces, gap between the concrete top surface and underside of base plate etc. shall be cleaned thoroughly by use of compressed air, just prior to taking up the grouting operations.				
6.04.0 Mixing					
6.04.01	Cement, sand, aggregate, and anti-shrinkage admixture of approved quality and proven make shall be first blended thoroughly in the required proportion as per manufacturer's specifications. Grout shall then be prepared by mixing this admixture with water and plasticizer. Any grout which has been mixed for a period longer than half an hour shall not be used on the work.				
6.05.0 Placing					
6.05.01	In case of fluid mix / plastic mix, a grout of suitable mix shall be poured immediately after preparation, into the block outs, pockets, bolt holes, the space between the top surface of the foundation concrete and the underside of the base plate either from the sides or through the holes provided for this purpose in the base plate, by using special equipment for pressure grouting. It shall be ensured by rodding and by tapping of bolts that the block out is completely filled with grout without leaving any voids. The pouring shall cease as soon as each hole is filled and any excess grout found on the surface of the concrete foundation shall be completely removed and the surface dried. Grouting, once commenced, shall be done continuously. Grout shall be worked from one end to the other (to prevent air entrapment) until the grout oozes out through the grout holes provided in the base plates.				
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6.05.02	In case of stiff mix, the space between the top surface of foundation concrete and the underside of the base plate shall be dry packed by firmly pressing or ramming into place against fixed supports.				
6.05.03	When it is clear that the center of base has been properly filled, the grout outside the base plate shall be briefly rammed to ensure compaction below the edges. Shims provided for the alignment of bases shall be positioned at the edges of the base to permit subsequent removal, which shall take place not less than 7 days after the grouting has been executed. The resulting cavities shall be made good with the same grade of grout as has been used for grouting under the rest of the base plate.				
6.06.00	Curing The work shall be cured for a period of at least 7 days commencing 24 hours after the completion of the grouting. The curing shall be done by covering the surfaces with wet gunny bags and flooding.				
7.00.0	JOINTS IN CONCRETE				
7.01.0	General Requirements				
7.01.01	This part of the specification covers the requirements for providing and installation of bitumen-impregnated fibre board, PVC water stops, sealing compound, expanded polystyrene board, hydro swelling joint sealing flexible strip, cement slurry modified with acrylic polymer, etc.				
7.01.02	These shall be used along with items like precast coping, creating / cutting of groove in concrete, precast tile cover, dowel bars, metal cover strips, etc., to make construction and expansion joints of different types.				
7.02.0	Materials				
7.02.01	The bitumen impregnated fibre board, a preformed material shall conform to IS 1838.				
7.02.02	PVC water stops shall generally meet the stipulations of IS 12200.				
7.02.03	The bitumen sealing compound shall be of grade-A and shall conform to the requirements of IS 1834.				
7.02.04	The two-part polysulphide sealant shall conform to IS 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified.				
7.02.05	Metal cover strips shall be made from anodised aluminium sections as shown on drawings. The minimum thickness of aluminium strips shall be 3 mm.				
7.02.06	Expanded polystyrene board shall conform to IS 4671. This shall be of non-self- extinguishing type (type1). Nominal apparent density shall be 20 kg/m3. Minimum compressive strength at 10% deformation shall be 0.9 kg/cm2. Moisture absorption percentage shall not be more than 1%.				
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The nominal panel size of each board and thickness shall be as specified in the schedule of items. Tolerance in length, width and thickness of the polystyrene board shall be + 2 mm.			
7.02.07 Hydro swelling joint sealing flexible strip shall be of nominal size 20 mm x 5 mm and made of hydrophillic expanding rubber combined with chloroprene rubber. The material shall expand when comes in contact with water. Expansion ratio shall be 10 times when in contact with potable water. Tensile strength shall be 70 kg/cm² (min.) and elongation 600% (min.)			
7.02.08 Acrylic polymer to be used with cement slurry shall be as approved by the Engineer.			
7.03.0 Installation			
7.03.01 The bitumen impregnated fibre board may be secured to vertical concrete by nails in the first placed concrete. The joint filler shall be coated on both faces with coal-tar pitch conforming to IS 216 or bitumen of suitable grade conforming to IS 73 or IS 702.			
7.03.02 In PVC water stops, splice joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps, etc. shall be as specified by the manufacturer and / or approved by the Engineer, taking particular care to match the center and the edges accurately. Particular care shall be taken for the correct positioning of the water stops to prevent any faulty installation which may result in joint leakage. Adequate provisions shall be made to support the water stops during progress of work and to ensure their proper embedment in the concrete. The symmetrical halves of the water stops shall be equally divided between the concrete pours adjacent to the joints. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working in the vicinity of joints. However, particular care should be exercised in use of vibrators in the proximity of joints to avoid dislodging of the water stops.			
7.03.03 When directed, the groove of specified dimensions for sealing purpose (for construction / contraction joints) shall be formed in the concrete. The gap in joints shall be thoroughly cleaned and then filled with sealing compound as per manufacturer's specification and approved drawings. Primer shall be applied as per manufacturer's specification.			
7.03.04 The metal cover strips shall be screwed (using stainless steel / aluminium alloyed screws) at one end on the normal circular hole and on the other end with a slotted hole. Welding of aluminium shall be in accordance with IS 2812.			
7.03.05 Precast coping, creating groove in concrete, precast tile cover, dowel bar, metal strips, sealing compound, etc, which are required for joints in the concrete are covered elsewhere in this specification.			
7.03.06 For application of polymer modified cement slurry for providing bond between hardened concrete and fresh concrete, acrylic polymer shall be mixed with neat			
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		cement. Normally 1 litre (1 kg) of polymer compound shall be mixed with 3 kg of cement and 1 litre of water. Minimum 2 kg of this mix shall be provided per sq.m. area of the concrete surface. This dose shall be based on nominal solid polymer content of 43% in the polymeric compound. In case, actual polymer content is less, the dose of polymeric compound shall be proportionally increased. The concrete surface shall be prepared to achieve a clean sound surface with a good mechanical key. Laitance shall be removed by mechanical means and thoroughly washed with clean water. Immediately before priming with cement slurry, the concrete sub strata shall be thoroughly dampened with water. Concrete shall be poured when the slurry is still tacky. This shall preferably be carried out within fifteen minutes.	
8.00.0		DISMANTLING AND CHIPPING WORK	
8.01.0		General Requirements	
8.01.01		The dismantling implies, breaking up of a structure / member, in part or full, without damage to balance or adjoining structure.	
8.01.02		The chipping work shall include removing of the concrete from the surface, making grooves of specified size, etc., in concrete members.	
8.01.03		All materials obtained from dismantling and chipping shall be the property of the owner.	
8.01.04		All dismantling work shall be carried out in conformity with the local safety regulations, extreme caution being exercised to avoid damage to the work and the equipment, which are to be left intact. Necessary precautions shall be taken to keep the dust nuisance down. Safety requirements stipulated in IS: 4130 shall also be followed.	
8.01.05		Making of circular/slit type opening, of the specified diameter/size, at the specified position and level, shall be done by using the coring/sawing machine. Before making the opening, the location of the reinforcement bar in the concrete shall be detected by using rebar detector. In case the cutting of the reinforcement bars is involved in creating the opening, then the specific clearance shall be obtained from the Engineer before proceeding with the cutting of reinforcement or creation of opening.	
8.01.06		Cutting of Pavement Slab Cutting of pavement slab to be done by deploying diamond saw cutting machine capable of cutting reinforced cement concrete of thickness up to 300mm, including underlying PCC. All cutting shall be along the pre-defined path. Before start of cutting, the specific cutting path and extent to be marked and got approved by Engineer.	
8.02.00		Stacking and Disposal All serviceable materials obtained, shall be separated out and stacked properly upto a lead of 500 metre and all unserviceable materials, rubbish etc., shall be disposed off as directed by the Engineer upto a lead of 2 km beyond the plant boundary.	
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		The dismantled / chipped materials shall be lowered to the ground and not thrown and then properly stacked as directed by the Engineer.	
8.03.00		Propping & Shoring Necessary propping, shoring and under-pinning shall be provided for the safety of the adjoining work or property which is to be left intact, before dismantling / chipping work.	
8.04.00		Cutting of Reinforcement This shall be done by hacksaw / gas/coring/sawing or as approved by Engineer.	
8.05.00		Enclosure Wherever required, temporary enclosures shall be erected to minimise the disturbance to the people working in the adjoining area.	
9.00.0		PRECAST CONCRETE	
9.01.0		General	
9.01.01		This part of the specification covers the requirement of all types of pre-cast concrete units for all kinds of works.	
9.01.02		Pre-cast concrete units shall generally be in the form of trench / floor cover, drain cover, fin, fascia, coping, lintel, chajja, wall panel, blocks for road edging, kerb block, separator block for road, roof unit, etc.	
9.02.00		Grade of Concrete The grade of the concrete shall be M-25. Mixing, batching, compacting, curing, etc, of concrete shall conform to IS 456. The size of aggregate shall be 20 mm / 12.5 mm / 10 mm as required.	
9.03.00		Form Work The formwork for the pre-cast units shall be made up of plywood so as to obtain a smooth surface after the forms are struck.	
9.04.00		Reinforcement The reinforcement shall be provided as indicated on the drawing. However, in case of any changes, joint records/registers of deviations shall be maintained as specified in clause no 1.7.2 in Appendix-IV to Part-A of the Technical specification.	
9.05.00		Casting The casting of precast unit shall be done in a yard developed by the contractor specifically for casting of precast units in the project site. This pre-casting yard shall have hard and levelled platform. The contractor shall arrange for all the necessary facilities like shed, casting bed, curing tank, handling equipment, storage,	
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		transportation, etc. complete. Casting of precast unit shall be done in a way similar to placing cast-in-situ concrete. Each pre-cast unit shall be suitably marked to indicate the top of the unit and its location and orientation in the structure and date of casting in order to facilitate in distinguishing the dates of casting of various units.				
9.06.00	Finishing	Top surface shall be rendered wherever required with cement sand mortar (1: 3) to give smooth surface.				
9.07.00	Steel Embedments / Inserts	Steel embedments / inserts shall be provided in various pre-cast members as indicated on the drawings.				
9.08.00	Handling	To ensure minimum damage during handling, the contractor shall provide suitable cranes capable of lifting the heavy pieces on to the curing tanks, stacking shed and on to the places of erection. The responsibility for any damage for whatsoever reasons it may be, shall be that of the contractor and he shall replace the damaged units.				
9.09.00	Curing	Either natural curing with water or an accelerated curing using steam shall be followed. Water curing shall be carried out for a period specified for cast-in-situ concrete. This shall be done in a curing tank wherein the pre-cast members shall be immersed.				
9.10.0 Erection						
9.10.01		The erection of precast units to the specified location shall be done as indicated on the working drawings. The contractor shall provide erection scheme indicating the deployment of crane, etc, to the Engineer before commencement of erection.				
9.10.02		The pre-cast roof units / slabs shall generally rest on the steel / concrete structure. Precast blocks for road edging / kerb / separator shall be laid on prepared sub- grade.				
9.10.03		The pre-cast units resting on to the structural steel shall be welded in position.				
9.10.04		After the erection of the precast elements at site, the hooks provided for lifting purpose shall be cut and finished smooth.				
9.10.05	Setting in position	The precast element shall be set in position with 1:3 cement mortar. After erection, the gaps between pre-cast units shall be filled with cement mortar 1:3 or with concrete of mix M-30 i.e. one grade higher-than that of precast unit.				
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10.00.0 RECORDS OF CONSTRUCTION All records of concreting, reinforcement, testing of materials, as-built dimensions, tolerances, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference. - Testing data of aggregates - Mix design details. - Testing records of admixture including dosage, workability and setting time. - Approved scheme for concreting. - Quantity of ice used for temperature control of concrete for top decks of machine foundations. - Hourly records of concreting including pour card. - Protocol indicating the dimensional tolerance and details of inserts. - Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used. - Bar bending schedule. - Location and details of mechanical anchoring used for reinforcement. - Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings. - Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification. - Report on petrographic examination & potential reactivity of aggregate and the repeated temperature cycle tests. 11.00.00 SAMPLING, TESTING, ACCEPTANCE CRITERIA INCLUDING CONSTRUCTION TOLERANCES 11.01.00 Frequency of sampling, testing and quality assurance including the method of conducting the tests, acceptance criteria and construction tolerances shall be as given in Part-C of this specification. 12.00.00 RATES AND MEASUREMENTS 12.01.00 Rates This clause shall be read in conjunction with the clause for the unit rate given in part A of the technical specifications. 12.02.00 Measurements			
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This clause shall be read in conjunction with the clause for the measurements given in part A of the technical specifications.					
12.02.01		Cast in Situ concreting			
		a) Actual volume of concrete work as executed or as per drawings issued, whichever is less, shall be measured in cubic metre. b) All concrete, formwork & reinforcement work associated with paving at ground floor of building / paving shall be measured & paid as works above ground level. c) All concrete, formwork & reinforcement work associated with concrete work in plinth i.e., above the ground level & upto plinth (e.g., in columns, plinth beams, encasement of steel columns etc.) shall be measured & paid as works below ground level. d) No deductions shall be made for following: i) Opening upto 0.1 Sq. m in cross sectional area. ii) Volume occupied by reinforcement, sleeves, anchor bolts and similar items. iii) Volume occupied by pipes, conduits, etc. not exceeding 100 Sq. cm. each in cross sectional area. e) For temperature control measures, measurement shall be done in terms of quantity of concrete in cu.m. in concreting of which the ice have been used to keep the temperature of freshly laid concrete to less than 25°C. f) Fly ash to be mixed with OPC shall be measured in Tonne of the actual quantity used. g) Hot applied bitumen treatment on concrete surfaces shall be measured in Sq.m. of the area provided with the treatment.			
12.02.02		Reinforcement			
		a) Bar or any other type of reinforcement for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length whichever is less, by the sectional weights. The theoretical length shall be computed from the approved bar bending schedules. Measurement for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS section weight. Nothing extra will be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement. b) Standard hooks, cranks, bends, authorized laps, supports, hangers and chairs, which are covered in approved bar bending schedule, shall be measured in tonnes.			
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12.02.03 Formwork					
a) Formwork shall be measured as the actual surface of formwork provided and in contact with the concrete and shall be paid on area basis. The unit of measurement shall be in Sq.m. b) Openings upto 0.1 Sq. m. of cross-sectional area or boxing left for inserts etc. shall be neglected as if non-existent for the purpose of formwork measurement of surface in which the openings occur. c) Measurement for the formwork in pockets, openings, chases, block outs, etc. in concrete shall be done for the contact surface area. d) For suspended floor, no deduction shall be made for flange area of supporting steel beams. Further the unit rate shall account for difficulty, wastage etc. for placement / removal of formwork between the network of closely placed steel beams, etc.					
12.02.04 Embedded Parts					
a) Measurement for embedded steel parts shall be done for the actual weight of the embedments installed, in tonne. b) For PVC pipes / conduits, measurements shall be in quintals for the actual weight of the embedments installed. c) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated and installed. d) Measurement of embedded steel parts, which are fabricated & erected by the contractor at site shall be done under the item of structural steel works.					
12.02.05 Grouting / Under pinning					
a) Measurement shall be in Cubic Decimeters. b) Measurement for grouting shall be by volume of the blockout, pockets, bolt hole and the space between the top surface of the foundation concrete and the underside of the base plate, and shall be calculated from the dimensions being as indicated on the drawings. c) No deduction shall be made for shims, bolts, shear keys and such other embedments.					
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12.02.06 Joints in Concrete					
a) Bitumen Impregnated Fibre Board.					
The measurement for this shall be based on actual finished surface area in Sq. m. for the specified thickness.					
b) PVC Water Stops					
The measurement for this shall be in running metres of actual length of the joint covered, for specified thickness, width and shapes.					
c) Sealing Compound					
The measurement for sealing compound shall be in kilograms of the actual compound, placed in the joint or as per theoretical calculations whichever is less.					
d) Cement slurry modified with acrylic polymer					
The measurement for this shall be based on the actual surface area of the concrete at the location of the construction joint on which the cement slurry modified with acrylic polymer is applied.					
12.02.07 Dismantling and chipping					
a) Dismantling of concrete work (both PCC and RCC work for all grades) shall be measured in Cu.m. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed.					
b) Chipping of concrete, shall be measured in cubic decimeters.					
c) Making of circular opening shall be measured in Sq.m. for the surface area of the opening. Surface area shall be arrived at by multiplying the perimeter of the opening with the depth of the opening and considering all the openings made at that particular location together.					
d) Making slit type opening shall be measured in Sq.m. taking all the surface area of the openings. Surface area shall be arrived at by multiplying the perimeter of the opening with the depth of the opening and considering all the openings made at that particular location together.					
e) Cutting of pavement slab, including cutting of underlying PCC, shall be measured in Sq.m. of the cut surface (cross-sectional) area of the reinforced concrete slab.					
12.02.08 Pre-Cast Concrete					
The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metre. No deduction shall be made for volume occupied by reinforcement / inserts / sleeves and for openings having cross sectional area up to 0.1 Sq.m. The filling of concrete /cement mortar between the gaps of adjacent pre-					
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Clause No.		CAST-IN-SITU CONCRETE AND ALLIED WORKS			
cast units shall be considered while computing the volume of pre-cast concrete work. Reinforcement and steel embedments / inserts (including lifting hook) shall be paid separately under reinforcement and structural steel works respectively. In case, Engineer permits admixtures then the same shall be measured and paid separately under relevant item of works. 50% payment of the unit rate shall be made after the precast concrete units are ready for erection. The balance 50% payment of the unit rate shall be made only after erection and finishing.					
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	SECTION-3 FABRICATION AND ERECTION OF STRUCTURAL STEEL WORKS 1.00.00 GENERAL REQUIREMENTS 1.01.00 Content This section covers the technical requirements for foundation bolt, fabrication and erection of structural steel, CW pipes, painting, electro-forged gratings, mild steel and high strength permanent bolts, dismantling, addition to, alterations in and / or modification, re-erection, PTFE bearings, stainless steel hopper, steel flue liner, neoprene bellow straps, stainless steel hand-railing and similar works. 1.2.1 Codes and Standards 1.2.2 Some of the relevant applicable Indian Codes, Standards and Acts are referred to herein below: (a) Materials 1. IS 808 Dimensions for Rolled Steel Beam, Channel and Angle Sections 2. IS 814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel 3. IS 1161 Steel Tubes for structural purposes 4. IS 1363 Hexagon Head Bolts, Screws and Nuts of Production Parts 1 - 3 : Grade C 5. IS 1364 Hexagon Head Bolts, Screws and Nuts of Production Parts 1 - 5 : Grade A and B 6. IS 1367 Technical supply conditions for Threaded Part-1 Fasteners 7. IS 1367 Technical supply conditions for Threaded Fasteners Part - 2 : Product Grade and Tolerances. 8. IS 1367 Mechanical Properties and Test Methods Part - 3 For Bolts, Screws and Studs With full loadability 9. IS 1367 Mechanical Properties and Test Methods Part - 6 For Nuts with Specified Proof Load. 10. IS 1367 Surface discontinuities on Bolts Part - 9 (Sections 1 and 2) 11. IS 1367 Hot Dip Galvanized Coating on Threaded Part - 13 Fasteners.				
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	12. IS 1852 Specification for Rolling and Cutting Tolerances for Hot Rolled Steel Products 13. IS 2016 Specification for Plain Washers 14. IS 2062 Steel for General Structural Purposes 15. IS 3063 Specification of Single Coil Rectangular Spring Washers for Bolts, Nuts and Screws 16. IS 3502 Specifications for Steel Chequered Plate 17. IS 3757 Specification for High Strength Structural Bolts 18. IS 4218 Specification for Isometric Screw Threads 19. IS 4923 Specification for Hollow Steel Sections for Structural use 20. IS 5369 General requirements for Plain Washers and Lock Washers 21. IS 5624 Specification for Foundation Bolts 22. IS 6623 Specification for High Strength Structural Nuts 23. IS 6639 Specification for Hexagon Bolts for Steel Structures 24. IS 6649 Specification for Hardened and Tempered Washer for High Strength Structural Bolts and Nuts 25. IS 6911 Specification for Stainless Steel Plate, Sheet and Strip 26. IS 8500 Specification for Structural Steel Micro-Alloyed (Medium and high Strength qualities) 27. IS 13238 Specification for Epoxy Based Zinc Silicate Primer (Two Pack) 28. IS 13239 Epoxy Surfacer (Two Pack) 29. IS 13467 Chlorinated Rubber for Paints 30. IS 14209 Epoxy Enamel Two Component Glossy 31. ASTM A240/ A240M Standard specification for Chromium and Chromium-Nickel Stainless Steel Plate (B) Codes of Practice 1. IS 800 Code of Practice for General Construction in Steel			
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	2.	IS 813	Scheme of symbols for welding		
	3.	IS 816	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel		
	4.	IS 817	Code of Practice for Training and Testing of Metal Arc Welders		
	5.	IS 1024	Code of Practice for Use of welding in Bridges and Substructure subject to Dynamic Loading		
	6.	IS 1477	Code of Practice for Finishing of Ferrous Metals in Buildings - Painting and Allied Finishes		
	7.	IS 2629	Recommended Practices for Hot Dip Galvanising of Iron and Steel		
	8.	IS 2811	Recommendations for Manual Tungsten Inert Gas Arc Welding of Stainless Steel		
	9.	IS 3696	Safety Code of Scaffolds and Ladders		
	10.	IS 4000	Code of Practice for High Strength Bolts in Steel Structure		
	11.	IS 4353	Recommendations for Submerged Arc welding of Mild Steel and Low Alloy Steels		
	12.	IS 4759	Hot Dip Zinc Coating on Structural Steel and Other Allied Products		
	13.	IS 5206	Covered Electrodes for Manual Metal Arc Welding of Stainless Steel and other similar High Alloy Steels		
	14.	IS 7205	Safety Code for Erection of Structural Steel		
	15.	IS 7215	Tolerances for Fabrication of Steel Structures		
	16.	IS 7293	Safety Code for working with Construction Machinery		
	17.	IS 7318	Fusion Welding of Steel-Approval Test for Welders		
	18.	IS 9178	Criteria for Design of Steel Bins for Storage of Bulk Materials		
	19.	IS 9595	Recommendations for Metal Arc Welding of Carbon and Carbon-Manganese Steels		
	20.	IS 12843	Tolerance for Erection of Structural Steel		
	21.	SP 6 Parts 1-7	ISI Hand Book for Structural Engineers		
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	22.	ISO 898/2 Mechanical Properties of Nuts			
	23.	ISO 3269 Fasteners - Acceptance Inspection			
	(C)	Standards for Testing			
	1.	IS 228 Methods of Chemical Analysis of Steels			
	2.	IS 1181 Qualifying Tests for Metal Arc Welders (Engaged in welding structures other than Pipes)			
	3.	IS 182 Recommended Practice for Radiographic Examination of Fusion Welded Butt Joints in Steel Plates			
	4.	IS 1599 Method of Bend Test			
	5.	IS 608 Mechanical Testing of Metals - Tensile Testing			
	6.	IS 2595 Code of Practice for Radiographic Testing			
	7.	IS 2614 Method of Sampling of Fasteners			
	8.	IS 3613 Acceptance Tests for Wire Flux Combination for Submerged Arc Welding			
	9.	IS 3658 Code of Practice for Liquid Penetrant Flaw Detection			
	10.	IS 3664 Code of Practice for Ultrasonic Testing by Pulse Echo Method			
	11.	IS 5334 Code of Practice for Magnetic Particle Flaw Detection of Welds			
	12.	IS 6821 Methods of Sampling of Non Threaded Fasteners.			
	13.	IS 7307 Approval Test for welding Procedures			
		Part - 1 : Fusion welding of Steel.			
	14.	IS 7310 Approval Test for Welders working to approved welding			
		Part - 1: Procedure : Fusion welding of Steel.			
	15.	SSPC-PA2 Measurement of Dry Coating thickness with Magnetic Gages.			
	(D)	BS Codes			
		1. BS 4232 Surface finish of blast cleaned steel for painting			
	2. BS 5493 Protective Coating of Iron and Steel Structures against corrosion				
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2.00.00	FOUNDATION BOLT ASSEMBLY			
2.1.1	General			
2.1.2	Foundation bolt shall comprise of foundation bolts, nuts, lock nuts, anchor plates stiffener plates, protective tape etc.			
2.1.3	All foundation bolts other than nut and lock nuts shall be site-fabricated.			
2.1.4	Every bolt shall be provided with nut and lock nuts. The nut and lock nuts shall be of reputed make and manufacture as approved by the engineer.			
2.02.0	Material			
2.02.01	Foundation bolts shall generally conform to IS 5624.			
2.02.02	Mild steel bars used for the fabrication of bolt assembly shall conform to grade '1' of IS 432 and / or grade E250 quality 'A' of IS 2062.			
2.02.03	Hexagonal nuts and lock nuts shall conform to IS 1363 and IS 1364 up to M36 diameter and IS 5624 for M42 to M150 diameter.			
2.03.0	Fabrication			
2.03.01	The fabrication of bolt assemblies shall include threading, cutting, grinding, drilling, welding, etc. complete.			
2.03.02	All bolts, bolt assemblies, etc. shall be fabricated to the correct dimensions and shapes as shown on the drawings. The bolts shall have coarse pitch screw thread in the diameter range 8 to 64 mm and 6 mm pitch screw thread for diameter greater than 64 mm, as per IS 4218.			
2.03.03	For fabrication of any particular size of bolt indicated on the drawing, the diameter of the threaded portion of the bolt shall be considered as the diameter of the bolt.			
2.03.04	All nuts shall be of steel with well-formed hexagonal heads, unless specified otherwise, forged from solid metal and shall be dipped in hot boiled linseed oil as soon as these are made. The nuts shall fit well on the bolts.			
2.03.05	Splicing in the foundation bolt can be done with full strength butt weld, which shall be further strengthened by provision of stiffening ribs for the full strength of the bolt. While splicing the foundation bolts, it shall be ensured that not more than 25% of the foundation bolts of each pedestal are spliced.			
2.04.0	Erection			
2.04.01	During erection, necessary temporary members like template, bracing, supports, etc. to ensure proper positioning of the assemblies and alignment of the bolts and holding them firmly during concreting shall be provided by the contractor at his own cost.			
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2.04.02	All materials shall be erected in plumb and in level (unless otherwise specified) and at true locations as shown on the drawings.			
2.04.03	Fabrication and erection shall be carried out as per IS 800 welding shall conform to IS 816 and IS 9595.			
3.00.0	FABRICATION AND ERECTION OF STRUCTURAL STEEL			
3.01.0	General Requirements			
3.01.01	This covers fabrication, erection, alignment, welding, etc. of mild steel, medium and high tensile steel, at all levels, involving rolled sections including rounds, pipes / hollow sections, built-up sections fabricated out of plates, and / or rolled sections including pipes / hollow sections, chequered plates, in columns, beams, crane girder, gantry girders, roof trusses, portals, purlins, space frames, shear connectors, hangers, struts, monorail beams, galleries, stiffeners, wall beams, sheeting runners, brackets, stub columns, bracing, cleats, trestles, base plates, splice plates, chequered plate floorings, decking plates, floor plates, seal plates, diaphragm, steel frame grid over false ceiling, walkways, platforms, ladders, stairs, stringers, treads, landings, handrails, toe plates, M. S. rungs, insert plates, edge protection, embedments, lugs, posts, stays, gates, louvers, lacing, gusset plates, washers, bunkers, silos, hopper, all sampling and testing etc. all complete.			
3.01.02	The provisions of IS: 800 shall be followed as general guidance along with all other relevant Indian Standards, Codes and Acts, unless otherwise specifically mentioned.			
3.02.0	Material			
3.02.01	Mild Steel a) Rolled sections shall conform to grade designation E250, Quality A/BR and shall be semi-killed/ killed conforming to IS: 2062. Plates shall be of Grade designation E250, Quality BR, fully killed, conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolling. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalized and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS 4923 and shall be of minimum Grade YST 240. d) Chequered plate shall conform to IS 3502 and and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS 2062 or equivalent grade conforming to ASTM & BS standards only.			
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3.02.02	Medium and High Tensile Steel Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS: 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalized and shall also be 100% ultrasonically tested as per ASTM –A578 level BS2.			
3.02.03	Austenitic Stainless Steel Austenitic Stainless Steel shall be of designation UNS S31727 conforming to ASTM standard A240/A240M.			
3.02.04	All other materials (nuts, lock nuts), consumables etc. shall be as per applicable standards and codes.			
3.02.05	In case any defect like laminations is noticed in the steel sections and plates during fabrication and erection, same shall be immediately brought to the notice of the engineer, who shall direct the usage or non-usage of the same. However, in case of usage, the contractor shall take necessary precautions such as plug welding etc. and as directed by the engineer, without any extra cost to the owner.			
3.03.0	Drawings			
3.03.01	The design (scope) drawings shall be supplied by the owner. The development of the detailed (Fabrication) drawings, on the basis of these design drawings, shall be done by the contractor.			
3.03.02	The detailed drawings (fabrication drawings) shall show complete details including connection / welding / bolting details required for fabrication and erection of structural steel works, all complete, along with their respective bill of materials and design documents. "Design Documents" shall include design of all connections including weld / bolt sizes, brackets, cleats, etc.			
3.03.03	The Contractor shall furnish fabrication drawings. The fabrication drawings shall be prepared by an experienced specialist consultant (i.e. an engineering consultancy agency specializing in structural joint / connection design, detailing and preparation of fabrication drawings.) engaged by the Contractor for the work. The consultant shall be subject to approval of the Owner. The fabrication drawings shall be thoroughly checked by the detailing agency before submission.			
3.03.04	The Contractor can prepare the fabrication drawings himself, provided he has requisite in-house expertise and dedicated experienced manpower to undertake such design, detailing and preparation of fabrication drawings to the satisfaction of the Owner. Owner reserves the right to assess the in-house expertise & capabilities of the Contractor for undertaking the design, detailing and preparation of fabrication drawings before permitting him to prepare fabrication drawings himself. In case Owner is not satisfied with Contractors in-house expertise and capabilities, the Contractor shall necessarily engage an experienced specialist consultant as at 3.03.03 above. The fabrication drawings shall be thoroughly checked by the Contractor before submission.			
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3.03.05	Depending upon the capacity / capability of the specialist consultant for preparation of fabrication drawings there can be more than one specialist consultant, engaged for the purpose of preparation of fabrication drawings.			
3.03.06	The Contractor shall receive soft copy of the scope drawing by e-mail from Owner and Contractor or his detailer shall upload the soft copy of the fabrication drawings and design calculations by e-mail for Owner’s review and approval.			
3.03.07	All fabrication drawings shall be prepared on AutoCAD latest revision, as available on the date of bid opening.			
3.03.08	The fabrication drawings shall indicate complete details of fabrication and erection including all splicing details, lacing details, weld details, detailing of all joints, edge preparation details, bill of materials, as per mode of measurement specified elsewhere in this specification, schedule of permanent bolts and all other details in accordance with the standard structural engineering practice. Bill of materials shall have erection mark, section details, shape, size, unit weight, no. of pieces of each erection mark.			
3.03.09	The design calculations shall include the design of joints (shear and moment connections), gusset plate, weld calculations viz. size and length of welds, dia and number of bolts, erection and fabrication splices, shear cleat sizing, stiffener for built-up sections, center to center distance of stiffeners, size of gussets, brackets required for wall beams and other areas etc. in accordance with IS: 800 and other relevant standards.			
3.03.10	The fabrication drawings shall indicate identification (erection) marks for the purposes of dispatch and erection etc., Contractor shall ensure that fabrication drawing(s) are submitted along with relevant marking scheme. the marking scheme should include in tabular form the drawing number, title & corresponding erection marks, of all relevant drawings.			
3.03.11	In the fabrication drawings, quantities of different sections of structural steel material required shall be indicated. Fabrication drawings shall also give the abstract of quantities for the structures to be painted with different painting systems.			
3.03.12	The schedule for permanent bolts and nuts shall show the length, size, weight and numbers required for each fabricated member.			
3.03.13	The abstract of quantities (bill of material) shall indicate the following: a) Total weight of the erection mark b) Weight of the erection mark that is to be applied with chlorinated rubber based zinc phosphate primer. c) Weight of the erection mark that is to be blast cleaned and applied with inorganic zinc silicate primer. d) Weight of the erection mark that is to be finish painted with polyamide epoxy based paint.			
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3.03.14	e) Schedule of permanent bolts with their designation, length, numbers and weight. Each fabrication drawing shall prominently carry the following note: “Weight given in the bill of material is indicative only. The weight for the purpose of measurement and payment shall be checked at site based on mode of measurement as specified in the Measurement clause given in the Technical Specification. Further, number of pieces to be fabricated per erection mark as given in Bill of Materials shall be verified by site before taking up fabrication work.”			
3.03.15	Total responsibility for the correctness and completeness of the details shown in the fabrication drawings and design calculations shall lie with the contractor. In case any modification / dismantling / re-erection is required to be carried out due to incomplete details or mismatch / deficiency in the fabrication drawings and design calculations, the same shall be made good by the contractor, at his own cost. The cost of any materials (including steel) required for such rectification / modification work shall be borne by the contractor or else penal recovery at the rates specified under relevant clauses of special conditions of contract shall be applied and recovered. Approval of the design calculations and fabrication drawings by the engineer shall however not dilute or relieve in any manner, the contractor of his sole responsibility, for the correctness and completeness of the design calculations and details shown in the fabrication drawings, safety of the structure, good connections, erectability etc.			
3.03.16	The fabrication drawings along with the design calculations shall be submitted by Contractor to the Owner within three (03) weeks of release of scope / design drawings by the Owner, maintaining strictly the time duration specified hereunder. a) Fabrication drawings and design calculations shall be submitted to the Owner, only after the same have been thoroughly checked by the detailer. b) If any clarifications are required by the detailer on the design / scope drawings, the Contractor shall seek such clarification from the Owner, within one (01) week of the release of the design / scope drawing. c) The fabrication drawings along with the design calculations shall be submitted by the Contractor to the Owner within three (3) weeks of the release of scope / design drawings by the Owner.			
3.03.17	Owner shall approve the design calculations, and the fabrication drawings under Cat-IV / Cat-IVR / Cat-III.			
3.03.18	Following shall be the categories of approval accorded to the design calculations and the fabrication drawings by the Owner. Cat IV : Accepted for information purpose only. Cat IVR : Accepted for information purpose, however, drawing to be re-submitted after incorporating the comments as marked. Cat III : Not accepted and drawing to be re-submitted.			
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3.03.19	The Contractor shall submit to his site engineer at site one hard copy and one soft copy of the fabrication drawings approved under Cat-IV / Cat-IVR) on CDs or any other electronic media, as approved by the Owner.			
3.03.20	If it is found necessary to substitute alternative sections for any of the steel sections specified, then details of all such substitution, as duly approved by the Owner shall be incorporated in the as-built fabrication drawings by the Contractor. While substituting the alternate sections, joint records/ registers of deviations shall be maintained.			
3.03.21	Submission of As-built Fabrication Drawings by Contractor: If any change in the released for construction Fabrication drawings is required during currency of contract due to any reason whatsoever, the same shall be incorporated in the respective fabrication drawings and such corrections shall be jointly signed by the Engineer-in-charge and the contractor on regular basis before release of progressive payments and drawings shall be stamped as ‘As built drawing” and jointly signed by Contractor and Engineer-in-Charge after erection. Further, fabrication drawings where no modification is done at site after completion of erection shall also be stamped as “As built drawing” and jointly signed by the contractor and Engineer-in-charge. A set of all as built drawings shall be marked to D&E by Engineer-in-charge for records.			
3.03.22	The scope / design drawings may require revisions either before or after the preparation and approval of fabrication drawings and design calculations. The design drawings may also be released with holds, which are to be released subsequently. Such revisions and release of holds shall be duly incorporated by the Contractor at his own cost, in the fabrication drawings and design calculations already finalised and re-submit the same to the Owner. The Contractor is expected to make his own assumptions regarding the quantum of such revisions involving preparation / revision / checking of design calculations / fabrication drawings.			
3.03.23	Cost Recovery from Contractor for Non-submission of Fabrication Drawings It shall be the responsibility of the Contractor to ensure that the design calculations and fabrication drawings are submitted as per the time frame detailed above or as instructed by the Owner. He shall fix an engineering coordinator within 4 weeks of award of work to him, who shall coordinate with Owner’s engineer on weekly basis for reconciliation of design drawings, submission of corresponding design calculations and fabrication drawings and approval thereof and on any other issue in respect of quality of documentation etc. In case there is delay by the detailer (appointed by the Contractor) in submission of design calculations/fabrication drawings due to the reason of non-payment by the Contractor to detailer, then Owner reserves the right to get the design calculations/ fabrication drawings made by the detailer by making direct payment to detailer, on behalf of the Contractor, as per the cost indicated by the detailer to the Owner. Such payments made directly by Owner shall be recovered from the running bills of the Contractor. Further, in case there is delay by the Contractor/his detailer in submission of design calculations / fabrication drawings, the Owner reserves the right to get such work			
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3.04.0	Design of Connections				
	3.04.01	All field connections/joints shall have bolted connections (except CW/RW pipes) unless otherwise specified in the design / scope drawings. Bolts when used for connections shall be of mild steel, high strength steel and / or friction grips, as indicated in the scope / design drawings.			
	3.04.02	Fabrication drawings and design calculations shall be prepared according to the provision of IS: 800, IS: 816, IS: 1367, IS: 3757, IS: 4000, IS: 9178 and IS: 9595.			
	3.04.03	Connection of vertical bracing with connecting members and diagonals of truss members shall be designed for full tensile capacity of the bracing, unless actual loads are indicated on the design / scope drawings. In case of design for actual loads, then the connection shall be designed for actual loads or at least 60% tensile capacity of the member, whichever is more.			
	3.04.04	Size of fillet weld for flange to web connection for built-up section shall be as follows: - i) For box section weld size shall be designed for 60% of full shear capacity or actual shear if indicated in design / scope drawings, whichever is more. Wherever fillet weld is not possible, full strength full penetration butt weld shall be provided. ii) For built-up plated I-section, weld size shall be designed for 80% of full shear capacity or actual shear, if indicated in design / scope drawings, whichever is more. However, weld size shall not be less than 0.5 times the web thickness. Weld shall be of double fillet. iii) All structural welds shall be continuous and the minimum size of the Fillet weld shall be 6mm.			
	3.04.05	Shear connections shall be designed for 60% of section strength for rolled sections and 80% of section strength for built-up plated I-section or combination of rolled section with cover plates. However, if the load actually applied is more than the above-specified value, the connection shall be designed for actual applied load.			
	3.04.06	Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section.			
	3.04.07	All butt welds shall be of full strength full penetration butt welds.			
	3.04.08	Connection between top flange and web of crane girder shall be of full penetration butt weld. Bottom flange connection with web can be of fillet weld or butt weld, as directed by engineer.			
	3.04.09	Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, the minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners.			
3.05.00	Splicing				
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3.05.01	All splicing works shall be for full strength.
3.05.02	Shop splicing of all plates shall be carried out by full strength full penetration butt welds. Shop splicing for all rolled sections (beams, channels, angles, hollow sections, etc.) shall be carried out using web and flange cover plates. Shop splicing for solid round sections shall be done by combination of butt weld and stiffening (splice) plates.
3.05.03	Field splicing of built-up section shall be done using permanent bolts and splice cover plates. Splice cover plates shall be designed for the full strength.
3.06.0	Fabrication The fabrication of works shall be carried out generally in accordance with IS: 800 as well as with the stipulations contained in these specifications. The fabrication shall be done as per fabrication drawing which would clearly indicate various details of joints to be welded, type of weld, length and size of weld.
3.06.01	Factory Fabrication All steel structures except CW/RW pipes shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Before dispatching the fabricated structural members to site, it shall be ensured that all parts in the assembly fit accurately together by carrying out pre-assembly of fabricated structural members having bolted field joints, in the factory. All steelwork before and after manufacturing shall be smooth, straight and free of deformations, cracks, twists and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length and location of matching bolt holes for field connections.
3.06.02	Site Fabrication CW/RW pipes can be either be fabricated at factory, transported in segments, and welded at site before erection or fabricated at site.
3.06.03	Straightening All steel materials shall be straight and free from bends or twists. If the sections are distorted or twisted during transit, storage, etc. they shall be straightened and / or flattened, as directed by engineer, at an ambient temperature. Minor kinks or bends may however be corrected by limited heating under careful supervision.
3.06.04	Preparation of Cutting Plans The contractor shall prepare necessary cutting plans for all fabrication work taking into consideration the availability of materials and cut pieces generated during the work with the object of minimizing wastage. Care shall be taken by the contractor to ensure maximum utilization of cut pieces and if required by providing additional butt weld, at his own cost.
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3.06.05	Cutting	The cut edges of all plates / sections shall be perfectly straight and uniform throughout. Plates shall be cut with pug cutting machine only unless otherwise directed by the engineer. Gas cut edges shall be clean, square and free from distortion and burrs.
3.06.06	Bending and Rolling	Bending of plates and rolled sections to the specially required shapes for fabrication shall be done on plate bending machine or by cold bending process without resorting to heating, hammering, angle smithy and black smithy process.
3.06.07	Grinding	a) All the edges cut by flame shall be ground before they are welded. Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. b) In case of crane girders, the bottom of the knife-edge support shall be accurately ground to provide effective bearing on the column bracket. The top surface of column bracket shall also be ground similarly. c) The ends of column shafts together with attached gussets, stiffeners, angles, channels, etc. after welding together shall be accurately ground, so that the parts connected butt over the entire surface of contact. d) The column base slabs shall be similarly ground over the bearing surface and shall have effective contact with the end of the shaft. The bearing face that is to be grouted direct to a foundation need not be ground.
3.06.08	Clearances	The erection clearance for cleat ends of members connecting steel to steel shall not be greater than 2mm at each end, unless approved by the engineer.
3.06.09	Drilling	a) Holes through more than one thickness of material for members, such as compound stanchion and girders, flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. b) All holes in the washer plates shall be drilled using drilling / lathe machine. Small holes (having diameter up to and including 50mm), provided in the base plate for grouting, shall be made by drilling. Large holes (having diameter more than 50mm), provided in the base plate and or horizontal brackets plates directly welded to the column flange, for passage of the foundation bolt can be made by gas cutting and all surfaces obtained by gas cutting shall subsequently be made smooth by grinding / filing.
3.06.10	Assembly	a) The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the
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3.06.11		specified camber, if any is provided. If the individual components are to be bolted, parallel and tapered drifts shall be used to align the parts so that the bolts can be accurately positioned.			
	b)	Items like roof trusses, galleries, bunkers / hoppers, etc. shall be trial assembled keeping in view the actual site conditions, prior to dispatch to site for erection so that they can be conveniently pre-assembled before erection or conveniently pre-assembled during erection. Necessary match marks shall be made on these components before disassembly in the shop and dispatching.			
	c)	For columns which are fabricated in two or more parts, controlled / trial assembly shall be carried out in the pre assembly / fabrication yard before dispatch to the erection Site.			
	Bolting				
	a)	Bolting will involve the provision of bolts in clearance holes and/or high strength friction grip fasteners.			
3.07.0	b)	The diameter of the bolt hole shall be taken as the nominal diameter of the bolt plus 1.5mm, unless noted otherwise.			
	c)	Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.			
	d)	Flat washers shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads / nuts bear upon the beveled surfaces they shall be provided with the square tapered washers of suitable thickness to afford a seating square with the axis of the bolt as per satisfaction of engineer.			
	e)	All bolts and nuts shall be of steel, with well-formed hexagonal heads. The nuts shall be good fit on the bolts and minimum two clear threads shall show through the nut when it has been finally tightened up.			
	f)	Notwithstanding anything to the contrary contained in IS:1363, IS:1364, and IS:1367, the unthreaded length of the bolt shall be equal to total thickness of metal being bolted together plus 2mm. The threaded length shall be equal to at least the diameter of bolt plus 6mm.			
	g)	IS: 4000 shall be followed for high strength friction grip bolts.			
	Welding				
3.07.01	The works shall be done as per approved fabrication drawing which would clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld.				
3.07.02	Welding of structural steel shall be done by an electric arc process, submerged arc welding / MIG welding / manual metal arc welding. Welding shall conform generally to relevant acceptable standards viz. IS: 816, IS: 9595, IS: 814, IS: 1024, IS: 4353				
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	and Indian Standard hand book for metal arc welding, and other standards, codes of practice internationally accepted. For welding of any particular type of joint, contractor shall give evidence acceptable to the owner of having satisfactorily completed appropriate tests as described in any of the Indian Standards - IS 817, IS 7307 and international standard as relevant. 3.07.03 Welding process employing semi-automatic welding machine and / or MIG welding and / or fully automatic welding machine shall be used for welding longitudinal fillet welds (connecting flange with web) and butt joints for fabrication of columns, framing beams and crane girders, unless manual arc welding is specifically approved by the Engineer. Necessary jigs and fixtures and rotation of structural shall be so arranged that vertically down-hand position of welding becomes possible. 'open-arc-welding' process employing coated electrodes shall be employed for fabrication of other welded connections and field welding. 3.07.04 Wherever welding is done for assembling the components of structural, the job shall be so positioned that down-hand welding is possible. 3.07.05 Any structural joint shall be welded only by those welders who are qualified for all welding procedures and positions required in such a joint. 3.07.06 The Contractor shall maintain records of all the welders identification marks, the joints welded by each welder, the welding procedure adopted, welding machine employed, pre and post heating done and any non-destructive test done and stress relieving / heat treatment performed on such joints. All such records for entire welding operation shall be accessible to the engineer for scrutiny. 3.07.07 In fabrication of plated columns / beams and built-up members all shop splices in each component part shall be made before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fitting between components to be assembled for welding, these welds shall be ground flush prior to assembly. 3.07.08 The members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3mm. If the separation is 1.5mm or greater, the fillet weld size shall be increased by the amount of separation. 3.08.0 Electrodes 3.08.01 The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm. 3.08.02 All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.			
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3.08.03		Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.			
3.08.04		Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.			
3.08.05		Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.			
3.08.06		The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.			
3.09.0		Edge Preparation for Welding			
3.09.01		Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.			
3.10.0		Pre Heating and Post Heating			
3.10.01		Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.			
3.10.02		Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to at least 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress.			
		TABLE - 1			
		MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL			

		Welding Using			

		Thickness of thicker part at Low hydrogen Other			

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Point of welding	electrode or submerged arc welding	than low hydrogen electrode
Upto and including 20mm	None	None
Over 20mm and up to and including 40mm	20°C	66°C
Over 40mm and up to and including 63mm	66°C	Not allowed
Over 63mm	110°C	Not allowed

Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.

TABLE - 2

**MINIMUM PREHEAT AND INTERPASS TEMPERATURE
FOR WELDING MEDIUM / HIGH TENSILE STEEL**

Thickness of thicker part at of welding	Welding Using	
	Low hydrogen electrode or submerged arc welding	Other Point than low hydrogen electrode
Up to and including 20mm	None	Not Allowed
Over 20mm	120°C - 140°C	Not Allowed

Note: Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.

3.10.03 Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.

3.10.04 Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.

3.10.05 All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600°C and rate of application shall be 200°C per hour.

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3.10.06	3.10.06 The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.			
3.11.0	Welding Sequence			
3.11.01	The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect or by a counter distortion.			
3.11.02	The direction of welding should be away from the point of restraint and towards the point of maximum freedom.			
3.11.03	Each case shall be carefully studied before finally following a particular sequence of welding.			
3.11.04	Butt weld in flange plates and / or web plates shall be completed before the flanges and webs are welded together.			
3.11.05	The beam and column stiffeners shall preferably be welded to the webs before the web and flanges are assembled unless the web and flanges of the beam or column are assembled by automatic welding process.			
3.11.06	All welds shall be finished full and made with correct number of runs. The welds being kept free from slag and other inclusions. All adhering slag being removed from exposed faces immediately after such run.			
3.11.07	Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid as to leave the edges unmelted.			
3.11.08	Puddling shall be sufficient to enable the gases to escape from the molten metal before it solidifies.			
3.11.09	Non-uniform heating and cooling should be avoided to ensure that excessive stresses are not locked up resulting ultimately in cracks.			
3.11.10	The ends of butt welds shall have full throat thickness. This shall be obtained on all main butt welds by the use of run off and run on pieces adequately secured on either side of main plates. The width of these pieces shall not be less than the thickness of the thicker part joined. Additional metal remaining after the removal of extension pieces shall be removed by grinding or by other approved means and the ends and surface of the welds shall be smoothly finished. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the end of the butt welds shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.			
3.11.11	The fusion faces shall be carefully aligned. Presetting shall control Angle shrinkage. Correct gap and alignment shall be maintained during the welding operation.			
3.11.12	All main butt welds shall have complete penetration and back surface of the weld being gouged out clean before first run of the weld is given from the back. However, partial penetration butt weld shall be permitted, when specifically shown in the fabrication drawings.			
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3.11.13	Intermittent welds shall be permitted only when specifically approved in the fabrication drawings.				
3.11.14	The welding shrinkage shall be minimised by adopting the correct welding procedure and method. In long and slender member extra length should be provided at the time of fabrication for shrinkage.				
3.12.0	Testing Of Welders				
3.12.01	On the basis of the welding procedure, the contractor shall conduct qualification test. All the welders to be employed for the job shall have to qualify the appropriate tests laid down in IS 817 and IS 1181 and ASME IX / AWS D1.1.				
3.12.02	All necessary arrangements required for the testing of welders are to be provided by the contractor.				
3.13.0	Production Test plate				
3.13.01	Test plates shall be incorporated on either side of at least one main butt weld of each flange plate and web plate of every main frame column. The weld shall be continuous over the test plate. The test plate shall be cut from extensions of the main plates and shall be fixed so that metal lies in the same direction as that of the main plate. Test plates shall be prepared and tested in accordance with the accepted standards, in the presence of the weld or his authorised representative. The contractor shall provide all testing equipment and facilities for carrying out these tests. Should any of these tests fail, further radiographic examination of the welds shall be done. These tests for the test plates and radiographic examination are additional to those contemplated under part-C of this specification.				
3.14.0	Rectification and Correction				
3.14.01	Wherever defects like improper penetration, extensive presence of blow holes, undercuts, cracking, slag inclusion, etc. are noticed by visual Inspection / other tests, the welds, in such location shall be removed by gouging process. The joints shall be prepared again by cleaning the burrs and residual matters with wire brushes and grinding, if necessary, and re-welded. The gouging shall as far as possible be done using gouging electrodes.				
3.15.0	Correction of Defective welds				
3.15.01	Correction of defective welds shall be carried out as directed by owner without damaging the parent metal. When a crack in the weld is removed magnetic particle inspection or any other equally positive means shall be used to ensure that the whole of the crack and material up to 25mm beyond each end of the crack has been removed. Cost of all such tests and operation incidental to correction shall be to contractor's account.				
3.16.0	Erection and alignment				
3.16.01	Erection marks				
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3.16.02	Erection marks in accordance with approved fabrication drawing shall be clearly painted on the fabricated steelwork. Each piece shall be marked in at least two places. Each piece shall also have its weight marked thereon.			
	The center lines of all columns, elevations and beam bearings shall be marked on the sections to ensure proper alignment and assembly of the pieces at site.			
3.16.03	Erection Scheme			
	a)	The contractor shall submit for review of the weld his erection scheme for the erection of all types of structural.		
	b)	The contractor before commencement of fabrication work, to avoid any future modification shall check the erect-ability of the structural. The erection scheme shall indicate the approximate weight of the structural members, position of lifting hook, crane boom length, crane capacity at different boom length and at different boom inclination etc.		
	c)	The erection scheme shall also give details of the method of handling, transport, hoisting, including false work / staging, temporary bracing, guying, temporary strengthening etc. It will also give the complete details of the number and capacity of the various erection equipment that will be used such as cranes, winches, etc. along with disposition at the time of erection of column, trusses etc.		
	d)	The contractor shall examine the site conditions and transportation clearances before deciding whether columns, trusses, beams are to be transported in one piece or in more than one piece. All those steel members which are to be required to be erected in single piece but are transported in more than one piece shall be assembled, aligned bolted, welded, tested etc. on the proper assembly bed before erection at site.		
	e)	The erection of columns, trusses, trestles, portals, beams etc. shall be carried out in one single piece as far as practicable unless specified otherwise in the design drawing. conveyor galleries shall generally be erected as box pieces i.e. the bottom chord and bracing, top chord and bracing, side vertical posts and tracing, end portals and roof-trusses shall be completely welded prior to erection and if required temporary strengthening during erection shall be made.		
	f)	The sheeting runners and roof sheeting purlins may be erected individually. When erection joints are provided in columns, their location shall generally be just above a floor level.		
	g)	The structural steel shall be erected frame-wise. Thereafter, the frames shall be progressively aligned and all erection welding completed. The secondary beams shall thereafter be erected, aligned and welded bay wise / floor-wise.		
3.16.04	Embedding In Concrete			
	All embedments shall be placed true to level and location. It shall be ensured by the contractor by provision of the temporary members and if required by welding of			
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3.16.05	embedment lugs with nearby reinforcement. The embedments shall not be disturbed during concreting.
	Protection against Damage in Transit
	a) All steelwork shall be efficiently and sufficiently protected against damage in transit from fabrication yard to erection site from any cause whatsoever. All projecting plates and all ends of members at joints shall be stiffened.
	b) If the steel has been unduly bent in transit or during handling by the contractor which cannot be rectified in the opinion of the weld, such steel shall be counted as wastage and the cost recovered from the contractor at the time of reconciliation of the steel as per the provisions of the contract.
3.16.06	Stability of Structures
	The contractor shall be responsible for the stability of the structures at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations. Guying and bracing shall be done in such a way that it does not interfere with the movement or working of other agencies working in the area. For the purpose of guying, the contractor shall not use other structural in the vicinity, which are likely to be damaged by the guy.
3.16.07	Temporary Structures
	The stipulations contained in the Indian standard safety code for erection of structural steel work IS: 7205 shall be followed, for ensuring safety of men and material. This shall include provision of temporary structural by the contractor, at his own cost for proper approach and working platforms during the erection of structures to the satisfaction of weld. The contractor at his own cost shall provide any temporary strengthening needed. Temporary structures shall include access ladders, working platforms, railings etc. All temporary structures shall be subsequently dismantled and removed.
3.16.08	Setting Column Bases
	Column bases shall be set so that the column load is uniformly transmitted to the foundation. The contractor shall carefully check the location and layout of anchor bolts embedded in foundations to ensure that the structural can be properly erected as shown on the drawing. In some cases the bolts may be provided in the pipe sleeves / pockets in foundations for subsequent adjustment in final alignment of the foundation bolt. Before erection of columns on their foundations, the top surface of base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose material. The contractor shall be responsible to provide all packing and shim plates whatsoever required for erection of the structural at his own cost.
3.16.09	Alignment
	The contractor shall be responsible for the correct alignment and leveling of all steelwork on site to ensure that the columns are in plumb and all the structural are

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	erected conforming to the specified permissible erection tolerances. Welding works shall be done only after the approval of alignment of erected structural, by the weld. 4.00.0 CORROSION PROTECTION PAINTING SYSTEM 4.01.01 Painting of Steel Surfaces Embedded In Concrete a) For the portion of Steel surfaces embedded in Concrete (including CW/RW pipes), the surface shall be provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). For application of primer on CW /RW pipes, reference shall be made to the special provisions stipulated in the subsequent clauses. b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents. 4.01.02 Painting Of Steel Surfaces (Other Than Those Embedded In Concrete) a) Inorganic zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% $\pm 2\%$) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 1/2 finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00. b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% $\pm 2\%$) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% $\pm 2\%$) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. Notes: 1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70% relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. 2. The most frequent problem associated when top coating Primer is bubbling/pinholing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required.			
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	4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.				
	Preparation of Surface				
	For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning.				
	For the portion of Steel Surfaces, on which Inorganic zinc (ethyl) silicate primer coat is to be applied shall be prepared by blast cleaning conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. Approved material shall only be used for blast cleaning of steel surfaces. Immediately after blast cleaning of the steel surfaces, primer coat shall be applied onto the surfaces.				
	PERMANENT BOLTS, NUTS AND WASHERS				
	General Requirements				
	Permanent bolts shall be used for field connections only for those joints where so specified in the design document.				
	All bolts, nuts, washers shall be of reputed make as approved by the engineer.				
	Material				
Permanent Mild Steel Bolts					
The permanent mild steel bolts shall be of carbon steel of product Grade 'C' as per IS 1363 (part - 2). The technical supply condition shall be as per IS 1367 (part - I). The threads shall be of class 8g as per metric screw threads of IS 4218 (part - 6). The bolts shall be of diameter up to 39mm and shall conform to mechanical properties class 4.6 as per IS 1367 (part - 3).					
Permanent Mild Steel Nuts					
The permanent mild steel nuts shall be of carbon steel of product grade C meeting the requirements of IS 1363 (Part-2). The technical supply condition shall be as per IS 1367 (Part-1). The Threads shall be of tolerance class 7H as per metric screw threads as per IS 4218 (Part-6). The nuts up to diameter 16mm shall be of property class 5 and for diameters beyond 16mm and up to 39mm shall conform to property class either 4 or 5 as per the provisions of IS 1367 (Part-6) or ISO 898 / 2.					
Permanent Mild Steel Washers					
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5.02.04 5.02.05 5.02.06 5.03.0 5.03.01 5.03.02 6.00.0 6.01.0 6.01.01 6.01.02	The permanent mild steel washers shall be of ordinary grade conforming to the requirements of IS: 5369 and IS: 2016. The washers shall be supplied in natural finish.				
	Permanent High Strength Structural Bolts				
	The permanent high strength structural bolts shall be either of carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or carbon steel quenched and tempered of product grade C meeting the provisions of IS: 3757. The technical supply condition shall be as per IS 1367 (Part-1). The threads shall conform to tolerance class 6g of IS 4218 (Part-6). The bolts shall conform to mechanical properties class 8.8 as per IS 1367 (Part-3).				
	High Strength Structural Nuts				
	High strength structural nuts shall be of product grade B meeting the requirements of IS 6623. The technical supply condition shall be as per IS 1367. The threads shall confirm to tolerance class 6H as per metric screws threads of IS 4218 (Part-6). The nuts shall conform to property class 8 of IS:1367 (Part-6) / ISO:898 / 2 and all nuts shall be hardened and then tempered at temperature of at least 425°c.				
	Washers for High Strength Structural Bolts and Nuts				
	The various types of washers for use with high strength structural bolts and nuts shall be of ordinary grade as per IS 5369 and shall meet all the requirements of IS: 6649. The washer shall be made according to IS 1570 (Part-2). The washer shall be thorough hardened and tempered. Washer shall be supplied in dull back heat-treated condition with residual coating of light oil.				
	Installation				
	Installation of the high strength bolts / high strength friction grip bolts shall be as per the requirements specified in IS 4000.				
	Mild steel bolts shall be installed and placed in position as per IS 1363 / IS 1367.				
DISMANTLING					
Dismantling of Steel Work					
In case it is found that certain erection marks already erected at any elevation are to be dismantled for any reason whatsoever, this shall be done only on the written orders / permission of the engineer.					
Such dismantling shall be done carefully without damaging other structural and lowered to ground. Thereafter, it shall be carried to the field fabrication shop, if modifications are to be carried out or return to the project stores if the dismantled member is not to be re-erected at all. This operation may involve temporary dismantling, cutting, re-welding, supporting and restoring to correct position all temporarily dismantled members, realigning of all other adjacent connected members, to their correct positions as well.					
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CLAUSE NO.		 FABRICATION AND ERECTION OF STRUCTURAL STEEL WORKS 		
7.00.0		ADDITIONS TO, ALTERATIONS IN AND / OR MODIFICATION		
7.01.0		Modification of Erection Marks		
7.01.01		In case, it is found that certain erection marks as already detailed and approved in fabrication drawings, require additions, alterations and modifications; this shall be done on the written orders of the engineer. Wherever a modification is ordered, the contractor shall request the engineer in writing to examine the stage of completion of the erection mark. The weight of the erection mark (i.e. the calculated weight as per approved bill of materials) shall be recorded and termed as the unmodified weight of the erection mark.		
7.02.0		Additions To, Alterations In		
7.02.01		If additions to, alterations in and / or modifications are intimated before completion and acceptance of fabrication of erection marks as per originally approved fabrication drawings, such changes shall not be classified as additions to, alterations in and / or modifications of erection marks and no payment shall be due to the contractor for such additions, alterations and modification. If additions to, alterations in and / or modifications is ordered after completion and acceptance of fabrication and / or erection, payment shall be due to the contractor for additions to, alterations in and / or modifications.		
7.02.02		Normally the work of additions to, alterations in and / or modifications of erected erection marks shall be carried out in the erected position. Only in exceptional cases, where the engineer specifically approves that modification cannot be carried out in the erected position, the erection mark shall be dismantled.		
7.02.03		The work of additions to, alterations in and / or modifications may involve cutting of certain portions and parts, gouging of welds, cuttings, grinding, fabrication, welding, drilling holes specifically required for the work, straightening, raising to the required level, removal of bends, painting and touch up painting, transporting the cut and removed parts / items, pieces re-utilised out of cut and removed parts / items and new steel to be added. Wherever modification is involved it shall be done carefully without damaging other structural. In case of cutting from an erected member, the cut portion shall be safely lowered to the ground. Thereafter pieces not utilised out of such cut and removed parts shall be returned to the project stores if the weld feels that these cannot be used elsewhere. Further the member from where the piece / item has been cut shall be ground smooth at the cut joint location. Modification may involve temporary dismantling, cutting, re-welding, supporting and restoring to the correct position of all temporarily dismantled members realigning of other adjacent connected members as well. Modifications to erection marks at erection site shall involve transporting the fabricated part / items (pieces re-utilized out of cut and removed parts / items and or new steel added) to erection site, raising to required level and welding in position. Modifications to erection marks in fabrication yard shall involve turning and handling of structural.		
7.02.04		Additions to, alterations in and / or modifications may be ordered either before erection or after erection and may have to be carried out either in erected position at erection site on the ground or in the fabrication shop. The scheme of dismantling and modification wherever required shall be got approved by the engineer before the work is taken up.		
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8.00.00	RE-ERECTION OF ERECTION MARKS AFTER ADDITIONS, ALTERATIONS AND MODIFICATIONS
8.01.00	The items, where additions to, alterations in and / or modifications or change of erection mark have been ordered and such operations have necessarily to be carried out after dismantling, shall require re-erection.
8.02.00	The work of re-erection includes carriage of modified erection marks from the field fabrication shop to erection site, lifting of same to the required position, aligning, and erecting in position, inclusive of erection bolts, tack welding and final welding and touch up painting etc., all complete to the satisfaction of the engineer. The work shall also involve the re-erection of members which had to be temporarily dismantled including temporary dismantling, cutting, re-welding, supporting and restoring to the correct position of all temporarily dismantled members, realignment of other adjacent connected members including gouging of welds, realigning, re-welding, etc. of such members.
9.00.0	CW PIPES AND RAW WATER PIPES
9.01.00	General
9.01.01	This Section of the Specification covers the requirements for supply, fabrication, erection, installation and testing of CW/RW steel pipes, specials and fittings.
9.01.02	Temporary Stresses The Contractor shall check the stresses in the Pipes, fittings and specials, which may occur during manufacture, transportation, storage and installation and shall propose any modifications which he considers necessary to prevent damage.
9.01.03	Dimensions and Tolerances The dimensions and pipe wall thickness shall be as shown on the drawings. Pipes, stiffeners, fittings and specials shall be manufactured to such tolerance as allowed and the Contractor shall comply with the erection tolerances specified. Site dimensions shall be taken by the Contractor to ensure compliance with the specified tolerance and make-up pieces or end pipes shall be manufactured to these dimensions.
9.01.04	Flanges Flanges, including blank flanges, shall be manufactured from steel plate of grade suitable for the required duty. The flanges shall be plain faced and machined to a tool mark finish with a pitch of 1.3mm to 0.8mm. Serrations shall be spiral or concentric and the back of flanges shall be spot faced to duet heavy gauge washers. Flanges to lines and specials shall be at right-angles to the directional axis of the liner or special and shall be truly plane.
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9.01.05 9.01.06 9.02.0 9.02.01 9.02.02 9.02.03 9.02.04 9.03.0 9.03.01 9.03.02	Bends Bends shall be formed from splay out sections of pipe welded to the required shape as shown on the drawings. DELETED Workmanship Care shall be taken in handling and transporting pipes and specials so that their ends do not become damaged. Pipes with flanges shall be provided with a timber bank bolted to the flange face. Steel Pipes and Fittings Steel Pipes and fittings shall be manufactured from mild steel plate by butt welding. Welding shall be carried out by a Automatic/Semiautomatic arc welding process or manual electric arc welding. Welding and the testing of welds shall be carried out in accordance with the “Welding” Clause of the specification. Steel Flanges The flanges shall conform to the dimension shown on the drawings. The bolt hole circle shall be concentric to the bore. The hole shall be drilled with their center not more than 1mm from their true positions. The hole shall be located symmetrically of the center as shown on the drawings. Protective Coating Corrosion resistant painting system as per clause 4.00.00 shall be provided on machined faces, flanges and external exposed surfaces of CW/RW pipes. Installation Installation of Steel Pipes, Fittings and Specials All excavation of CW/RW trenches shall be carried out with as near vertical sides as reasonably possible. Backfilling above the specified concrete surround shall be selected from the excavation material unless shown otherwise on the drawings. If the excavated material is not suitable for filling, bidder shall backfill with suitable borrowed material. Strutting, Bracing and Anchoring Pipes and specials shall be strutted and braced internally by the Contractor so as to prevent distortion during transportation, storage, handling, erection and jointing.			
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CLAUSE NO.		FABRICATION AND ERECTION OF STRUCTURAL STEEL WORKS														
9.04.0	Sufficient anchorages shall be provided for each length of pipes to prevent uplift during the concreting operation and stools packs, etc. shall be provided at least at each anchorage point. All items shall be correctly located and brought into correct alignment and level, within the specified erection tolerances, before adjacent pieces are jointed or secured. Sleeved joint shall be made strictly in accordance with the recommendations of the coupling manufacturer. Upon completion of erection, the inside of the CW/RW pipes shall be cleared of all debris and foreign matter. Contractor has to arrange the necessary materials for strutting, bracing, stools, packs and anchoring and Owner will not issue, free issue materials for the above purpose and it shall not be measured.															
	Erection Tolerances Tolerances in erected liners shall be as follows: <table><tr><td>a)</td><td>At setting out points</td><td>± 25mm in position and level.</td></tr><tr><td>b)</td><td>Between setting out points</td><td>± 50mm in position and level.</td></tr><tr><td>c)</td><td>Flanges for condenser connections</td><td>± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.</td></tr><tr><td>d)</td><td>Other terminal points</td><td>± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.</td></tr></table>				a)	At setting out points	± 25mm in position and level.	b)	Between setting out points	± 50mm in position and level.	c)	Flanges for condenser connections	± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.	d)	Other terminal points	± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.
	a)	At setting out points	± 25mm in position and level.													
	b)	Between setting out points	± 50mm in position and level.													
	c)	Flanges for condenser connections	± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.													
d)	Other terminal points	± 6mm in position and level and the plane of the flange shall be within 3mm of the required plane measured across any diameter.														
Field Joints The field joints shall be butt welded joints with backing strip plate as shown in the drawing and in accordance with welding requirements given under clause no. 3.7.00. The Contractor shall submit drawings showing proposals for the position of all field joints which shall be kept minimum.																
Testing of Joints All tests of structural steel works and welding shall be as given under clause 15.00.00.																
9.07.0	Rubber Gasket for CW/RW Pipes Manhole															
9.07.01	Material															
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CLAUSE NO.		FABRICATION AND ERECTION OF STRUCTURAL STEEL WORKS		
9.07.02	The rubber gasket of type II, class 2A conforming to IS 11149 shall be provided in CW liner manhole, while fixing as manhole covers. The gasket shall be made up of natural of synthetic rubber or a blend of these may be used. Reclaimed rubber and ground vulcanised rubber may also be used. It shall have the following physical properties:			
	Hardness IRHD : 51 -60			
	Minimum tensile strength : 85 kg/cm ²			
	Minimum ultimate elongation : 200%			
	Compression set at 70 deg.C : 35			
	The gaskets shall be stored in cool and dark place to maintain in operation condition. If there is any doubt about the condition of the gasket they should be retested before fixing in the manhole. The thickness of the gasket shall be 8mm.			
	Installation			
	The gasket shall be installed on the manhole, before fixing MS manhole covers. Each bolt of the manhole, should be tightened a little at a time taking care to tighten diametrically opposite both alternatively. The practice of fully tightning both one after another is highly undesirable.			
	9.08.0 Hydrotesting of CW/RW Pipes			
	9.08.01 Method of Testing:			
10.00.00	CW/RW pipes shall be subjected to hydrostatic test pressure which shall be maximum of 1.5 times the design pressure or 2 times the working pressure and the same pressure be maintained for not less than one (1) hour for inspection. No leakage shall be observed by the Engineer for acceptance of the pipes.			
	The hydrostatic test may be performed in segments of minimum 100m length or as directed by the Engineer.			
	The Contractor shall be responsible for safe testing and if there are any damages either to pipe to any adjacent existing structures, he shall make them good at his own cost. After completion of the test and acceptance by Owner, he shall clear the area of all materials, equipment, debris, etc. and then only proceed for balance works.			
10.01.00		SAMPLING, TESTING, ACCEPTANCE CRITERIA AND TOLERANCES		
10.01.00		Frequency of sampling, testing and quality assurance including the method of conducting the tests, acceptance criteria and construction tolerances shall be as given in Part C of this specification.		
11.00.00		RATES MEASUREMENTS AND SCHEDULE OF PAYMENTS		
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	The qualifying weight for stage wise payment for such an erection mark shall be as under: a) For all stages completed and accepted by the engineer before modification, the qualifying weight shall be the unmodified weight of erection mark. b) After modification has been carried out and accepted by engineer, the stage wise payment for subsequent stages shall be for the modified weight of the erection mark. The modified weight of erection mark shall be sum of unmodified weight of erection Mark, weight of additional steel added, weight of steel re-utilized out of steel cut and removed less the weight of steel cut and removed. To clarify further the measurement and payment against this item, it is illustrated below through an example: a) Erection mark (column) 50 meters long weighing 40T is fabricated and applied with primer and has been erected at site and final alignment has been completed and erected structural is accepted by engineer. The following modification is ordered and carried out in the erected position in the erection mark. i) Existing cap plate is cut and removed weight 1.5T. ii) Column height is increased by 5.0M and weight by 6.0T. iii) Cap plate removed earlier is taken to fabrication yard and from this cap plate a stiffener of required size (weight 0.5T) is cut, fabricated and welded to the column. The unmodified weight of the erection mark shall be 40.0T. The modified weight of the erection mark shall be (40 - 1.5 + 6.0 + 0.5) = 45 T. b) If the rate of complete fabrication and erection work for an item in the schedule is Z and rate of application of primer is Y, then the total amount payable under the item, shall be as under: i) 0.45 x 40 x Z + 1.0 x 40 x Y deemed to be paid on account of completion of fabrication. ii) 0.20 x 40 x Z deemed to be paid on account of erection in position. iii) 0.15 x 40 x Z deemed to be paid on account of acceptance of erected structural. iv) 0.10 x 45.0 x Z payable on reconciliation of steel issued to contractor.			
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CLAUSE NO.	FABRICATION AND ERECTION OF STRUCTURAL STEEL WORKS				
11.03.03	v)0.10 x 45.0 x Z payable on sequential completion of the entire work.				
	Fabrication and Erection of CW Pipes and Raw water pipe The Schedule of payment for the item of fabrication & erection of CW/RW pipes shall be in the following stages: a)The contractor shall be entitled to payment of 65% of the unit rate for this item of work on acceptance of fabricated CW/RW pipe pieces at shop including shop tests of welds of the pieces. b)Further payment of 10% of the unit rate for this item of work shall be made after transportation to site, laying of pieces and field jointing including field weld tests. c)On acceptance of pipe lengths in segments after completion of hydrotesting of the same, 15% of the unit rate for this item shall be paid. d)Balance 10% of the unit rate for this item shall be made after completion of complete piping work for the unit including its final connections.				
	11.03.04 Bolts, Nuts and Washers, High Strength Structural Bolts Payment schedule for supply of permanent bolts, nuts washer, etc. shall be as follows: a)The contractor shall be entitled for 90% of the unit rate for this item of work on fixing of bolts in position as per bolt schedule and proper tightening of permanent bolts and acceptance of fabricated / erected structural where these bolts are used. b)The balance 10% of the unit rate for this item of work shall be released in the sequence of completed bays unit wise of structural where these permanent bolts etc. are used.				
	11.03.05 Dismantling, Additions to, Alterations and Re-Erection Works Payment schedule for the work of dismantling, additions, alternations re-erection etc. shall be as discussed below: a)For dismantling the unmodified weight of the actually dismantled erection marks shall only be considered for payment. The contractor shall be entitled the full payment as per the unit rate for this item of work after completion of dismantling work, restoration in correct position of temporarily dismantled				
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	member, transportation of dismantled member to the field fabrication shop or return to the project store. b) For the work of addition to, alteration in and for modification of "Erection Marks" either in erected position or in the fabrication yard the weight for payment shall be calculated as the sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark. The contractor shall be entitled to full payment as per unit rate for this item of work after acceptance of modified erection mark by the weld, restoration in correct position of temporarily dismantled member, realignment of adjacent connected member, return of steel pieces not utilised to the owner's / project store, etc. c) For re-erection, modified weight of erection mark shall only be considered for payment. The contractor shall be entitled to full payment as per unit rate for this item of work after acceptance of re-erected member by the engineer. To clarify further the measurement and payment against this item, it is illustrated below through an example: a) Erection mark (column) is 50 m long weighing 40 tonne is fabricated and lying in fabrication yard. The following modification is ordered and carried out in the fabrication yard. i) One-meter length of column (weight 2.50 T) is cut and removed. ii) Out of this 2.5 T cap plate (weight 0.50 T) is re-welded to column. iii) Another new stiffener (weight 0.10 T) is fabricated and welded to the column. b) The rate against this item is Rs. 'w' per tonne. The total amount payable for modification etc. shall be $(2.50 + 0.50 + 0.10) \times w$ i.e. $3.10 w$. c) The modified weight of the erection 'Mark shall be $(40.0 - 2.50 + 0.50 + 0.10) = 38.10$ Tonne.			
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS			
SECTION - 4					
MASONRY, SHEETING AND ALLIED WORKS					
1.00.00	GENERAL REQUIREMENT				
1.01.00	Contents				
	This section covers the technical requirement for brick masonry, plinth protection, DPC, dismantling, plastering, forming groove, wire netting, drip course, lath plaster, grading underbed, plaster of paris, painting, resin bonded granular coating, colour coated metal sheeting for decking, roofing & cladding, and other similar works				
1.02.00	Codes and Standards				
1.02.01	Some of the relevant Indian Standards, Codes, etc. (latest Edition) applicable to this section of the specification are listed below:				
	IS 277	Galvanised steel sheets (Plain or corrugated).			
	IS 428	Distemper, oil emulsion, colour as required.			
	IS 513	Cold rolled carbon steel sheets.			
	IS 737	Specification for wrought aluminium and aluminium alloy sheet and strips for general engineering purpose.			
	IS 801	Code of practice for use of cold formed light gauge steel structural members in general building construction.			
	IS 1077	Specification for common burnt clay bricks.			
	IS 1254	Specification for use of corrugated aluminium sheet.			
	IS 1905	Code of Practice for Structural Safety of Buildings - Masonry walls.			
	IS 2116	Specification for sand for masonry mortars.			
	IS 2212	Code of Practice for Brickwork.			
	IS 2250	Code of Practice for Preparation and Use of Masonry Mortar.			
	IS2395	Code of practice for painting concrete , masonry and plaster surfaces.			
	IS 2402	Code of practice for external rendered finishes.			
	IS 2547	Gypsum building plaster			
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS	
IS 3150		Hexagonal wire netting for general purpose.	
IS 3414		Design and installation of joints in buildings.	
IS 4326		Code of practice for earthquake resistant design and construction of buildings.	
IS 5411		Plastic emulsion paint.	
IS 7178		Technical supply conditions for tapping screw.	
IS 8147		Code of practice for use of aluminium alloy in structures IS 8183	
		Bonded mineral wool.	
IS 12118		Two parts polysulphide based sealants.	
IS 12436		Specification for preformed rigid polyurethane (Pur) and polyisocyanurate (Pir) foams for thermal insulation.	
IS 12894		Fly ash lime bricks	
IS 13204		Rigid phenolic foams for thermal insulation.	
IS 13757		Burnt clay fly ash building bricks.	
IS 14246		Continuously pre-painted galvanised steel sheets and coils SP 20	
		Explanatory hand book on masonry code.	
Australian Standards			
AS1365		Standards for Steel Manufacturing	
AS1397		A steel sheet & strip – Hot –dipped-zinc-coated or Aluminium-Zinc coated	
AS /NZS 2728		Pre-finished / pre-painted sheet metal product for interior/ exterior building applications–Performance requirements	
AS 3566		Self drilling screws for building and construction industry.	
1.03.00		Sequence	
		Commencement, scheduling and sequence of works, shall be planned in detail keeping in view the activities of other agencies working in that area and must be specifically approved by the Engineer. However, the Contractor shall remain fully responsible for all normal precautions and vigilance to prevent any damage to works whatsoever till handing over. Size and thickness of the topping/ tile shall be as specified as the schedules of items.	
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS		
1.04.00	Materials			
	A) All materials shall be of first quality.			
	B) For colour and shade, RAL nomenclature and the classification shall be followed.			
	C) Wherever working drawings are involved, the procurement of the material shall be done only after the preparation of working drawings including data sheets and approval of same by Engineer. All bought out items shall be procured from approved sub vendor as mentioned in part of this specification.			
1.05.00	Workmanship			
	Workmanship shall be as recommended by manufacturer (supplier of material) and approved by Engineer. Workers specially experienced in particular items of work shall only be engaged under the supervision of experienced supervisors recommended / appointed by the manufacturer.			
1.06.00	Handling & Transportation			
	All bought out items shall be protected, covered, boxed and crated properly before dispatch so that there will be no damage / deterioration during transportation, handling and storage at site till such time they are fixed in position. All materials shall be stored, dry in the covered shed / place over wooden sleeper with a stacking height not to exceed 2m.			
1.07.00	Working Drawings			
	Contractor shall prepare the detailed working drawings / data sheets for all bought out items, etc based on the scheme drawing/dimensions given by the Engineer. Working drawing / data sheets shall indicate the schedule of all hardware (fittings and fixture), fabrication details along with the section sizes, fixing details, bill of materials along with sectional weight and total weight, net area, numbers required, dimensions, material specification along with quantity for each type of material, reference to the applicable codes and standards, method of installing, workmanship, tolerance, acceptance criteria, etc.			
2.00.00	BRICK MASONRY			
2.01.00	General Requirement			
	This part of the specification covers the requirement for masonry work (with or without RCC band / reinforcement) in all kind of works such as foundations, walls, drains, manhole, pits, gully chambers, trenches, partition wall, enclosures, coping, parapet, culverts, risers, treads, etc. Masonry work shall be true to line & level as shown on drawings. All such masonry shall be tightly built against structural members and bonded with dowels, anchors, inserts, etc. as shown on the drawings.			
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Clause No.	MASONRY, SHEETING AND ALLIED WORKS				
2.02.00	Materials				
2.03.01	Cement shall be ordinary Portland cement (Grade 43) conforming to IS 8112 and / or fly ash based Portland pozzolona cement conforming to IS 1489 (Part-1) and or any other types of cement meeting the IS 456 requirement.				
2.03.02	Bricks shall be table moulded / machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75 kg/cm2. Burnt clay fly ash bricks and Pulverized Fuel ash-Lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.				
2.03.00	Mixing Mortar				
2.03.01	IS 2250 shall be followed as general guidance for preparation and use of mortar. Only cement-sand mortar shall be used.				
2.03.02	Unless otherwise specified, mortar for brickwork having one or more brick thickness shall be 1 part cement and 6 parts sand by volume. Mortar for half-brick thick walls shall be 1 part cement and 4 parts sand by volume.				
2.03.03	Mortar shall meet the compressive strength requirement as per IS 2250 and IS 1905.				
2.03.04	Sand shall conform to IS 2116 and grading shall be tested as per IS 2386 Sand shall be well graded and fineness modulus ranging between 2.1 and 2.7 shall conform to IS: 383.				
2.03.05	Cement and sand shall be thoroughly mixed dry in a mechanical mixer and water shall then be added to obtain a mortar of the consistency of a stiff paste, Hand mixing may be allowed by the Engineer on clean approved platform in special cases only.				
2.05.00	Laying				
	IS 2212 shall be followed as general guidance for construction of brick masonry. Vat/tank of suitable size shall be provided by the Contractor for soaking of the bricks.				
	Bricks shall be laid in English bond unless otherwise specified. Half brick masonry shall be laid with stretchers. In cases where reinforcement is considered necessary from structural consideration, 2 nos. 8 mm diameter bars at every third course or as specified on the drawings shall be provided generally				
	Bricks shall be laid generally with frogs upwards. The thickness of joints shall be kept uniform and shall not exceed 10 mm. Bricks shall be so laid that all joints are full of mortar. On completion of a course, all vertical joints shall be fully filled from the top with mortar.				
	Brickwork in walls shall be taken up truly plumb. All courses shall normally be laid truly horizontal unless indicated to be laid on slope and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. Brick wall shall be constructed with at least one plain face with proper alignment.				
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Clause No.	MASONRY, SHEETING AND ALLIED WORKS			
	All iron fixtures, pipes, water outlets, holdfasts for doors and windows, etc. which are required to be built into the brickwork shall be embedded in their correct position in mortar or cement concrete as the work proceeds as per directions of the Engineer. For external walls, the anchorage in the form of flats or rods from spandrel beams and columns and any other anchoring and reinforcement as shown on the drawing shall be adequately embedded in the masonry. The top courses of all plinth, parapet, steps and top wall below R.C.C. shall be laid with brick on edge (other than modular size bricks) unless otherwise specified. Care shall be taken that the bricks forming the top courses and ends of walls are properly radiated and keyed into position as shown on the drawings.			
2.05.00	Raking out joints			
	All face joints shall be raked to a minimum depth of 15mm by raking tools during the progress of brickwork, when the mortar is still green, so as to provide proper key for the plaster or pointing to be done. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face of the brickwork shall be cleaned on the same day on which brickwork is laid and all mortar droppings removed promptly. Brickwork shall be protected from rain by suitable covering when the mortar is green			
2.06.00	Scaffolding			
	Scaffolding shall be strong enough to withstand all the dead, live and impact loads which are likely to come upon it. It shall also be so designed as to ensure the safety of the workmen using them. For all brick masonry except for exposed brickwork, single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.			
2.07.00	Curing			
	Masonry work shall be cured by keeping it constantly moist on all faces for a minimum period of seven days. Brickwork carried out during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.			
3.00.00	PLINTH PROTECTION			
	Plinth of buildings shall be protected with concrete paving of minimum 750mm width unless otherwise shown on the drawings laid over graded stone filling. Plinth protection shall be laid with a minimum outward slope of 1 in 50 or as shown on the			
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		drawings. The concrete paving, stone filling are covered elsewhere in this specification.			
4.00.00		DAMP PROOF COURSE (DPC)			
4.02.00		Damp proof course shall be 50mm thick (unless, otherwise specified) concrete of minimum M-20 grade (with 12.5 mm nominal size graded aggregate) mixed with cement concrete admixture as approved by the Engineer.			
4.02.01		Edges of DPC shall be straight and even. The side shuttering shall be strong and properly fixed so that it does not get disturbed during compaction and mortar does not leak through. When the side shuttering is removed, the surface should be smooth without any honeycombing.			
4.03.00		The top surface shall be double chequered and cured by ponding for at least 7 days. The cement concrete shall be allowed to dry for at least 24 hours after curing and hot bitumen of grade 85/25 conforming to IS:702 at the rate of 1.7 kg/sq. metre shall be applied over the dried up surface of cement concrete after being properly cleaned with brushes and finally with a cloth soaked in kerosene oil. The bitumen shall be applied uniformly so that no blank spaces are left anywhere.			
4.04.00		The item of concreting, admixture, form work and hot bitumen are covered elsewhere in this specification.			
5.00.00		DISMANTLING			
5.01.00		General Requirements			
5.01.01		The dismantling implies, breaking up of a structure / member, in part or full, without damage to balance or adjoining structure.			
5.01.02		All materials obtained from dismantling shall be the property of the owner.			
5.01.03		All dismantling work shall be carried out in conformity with the local safety regulations, extreme caution being exercised to avoid damage to the work and the equipment, which are to be left intact. Necessary precautions shall be taken to keep the dust nuisance down. Safety requirements stipulated in IS: 4130 and other codes shall also be followed.			
5.02.00		Stacking and Disposal All serviceable materials obtained, shall be separated out and stacked properly upto a lead of 1 km. within plant boundary or alternatively used for filling within the plant boundary and compacting in lagoon to 85% of the original volume. All unserviceable materials, rubbish etc., shall be disposed off as directed by the Engineer upto a lead of 2 km beyond the plant boundary. The dismantled materials shall be lowered to the ground and not thrown and then properly stacked as directed by the Engineer.			
5.03.00		Propping & Shoring Necessary propping and shoring shall be provided for the safety of the adjoining work or property which is to be left intact, before dismantling / chipping work.			
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5.04.00	Cutting of Reinforcement	This shall be done by hacksaw / gas or as approved by Engineer.	
5.05.00	Enclosure	Wherever required, temporary enclosures shall be erected to minimise the disturbance to the people working in the adjoining area.	
6.00.00	PLASTERING		
6.01.00	General Requirements		
6.01.01		This covers the plastering of all types of concrete and or masonry surfaces in all kind of work .	
6.01.02		IS:1661 shall be followed as a general guidance for plastering work.	
6.02.00	Materials		
6.02.01		The cement shall be as specified for the brick masonry.	
6.02.02		Sand shall meet the requirements of IS 1542. Grading of sand shall be as per Table- I of IS 1542.	
6.02.03		Gypsum, for use in plaster-of-paris work shall be according to IS 2333.	
6.02.04		For lathe plastering, wherever specified galvanised hexagonal wire netting conforming to IS 3150 shall be used.	
6.03.00	Mixing / Mortar	Unless otherwise specified cement-sand mortar shall be used. Cement mortar shall be prepared by mixing cement and sand in specified proportions by volume in mechanical mixer. Cement and sand in the specified proportions shall be fed into the mixer and mixed dry thoroughly in the mixer. Water shall then be added gradually and the wet mixing continued for at least 3 minutes. Hand mixing may be allowed on a clean approved platform in special cases only. IS 2250 and IS 1661 shall be referred for ascertaining the quantity of water.	
6.04.00	Plastering	The mix proportion and thickness of plaster for various surfaces shall be as specified or shown in the drawings. Unless otherwise specified the following shall be adopted. All plastering shall conform to IS 1661.	
	i) Ceiling plaster	minimum 6mm thick, cement mortar (1:4)	
	ii) Plaster on rough	18 mm thick, cement mortar (1:6) face of masonry work	
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		iii) Plaster on plain face 12mm thick, cement mortar (1:6) of masonry work or concrete surface.	
6.05.00		Surface Preparation The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing, if it is not hard and by hacking when it is hard. In case of concrete surface, if a chemical retarder has been applied to the formwork, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface. Trimming of projections, wherever necessary shall be done to achieve an even surface. Raking of joints in case of brickwork where necessary shall be done. The masonry shall be allowed to dry out for sufficient period before plastering. For ceiling plaster, the concrete surface shall be pock marked with a pointed tool to ensure a proper key for the plaster. The wall shall be damped evenly and not soaked before application of plaster. If the surface becomes dry in spots, such areas shall be moistened again.	
6.06.00		Application of Plaster	
6.06.01		Unless otherwise stated, the plastering above 12 mm thick shall be carried out in two coats only.	
		i) The backing or first coat The backing coat shall be 10 to 12 mm thick and carried to the full length of the wall or to natural breaking points like doors and windows. Before the rendering coat hardens, it shall be roughened to provide mechanical key for the second coat. ii) Finishing Coat Before starting to apply the finishing coat, the surface of the backing coat shall be damped evenly. The finishing coat shall be approximately 3 to 8 mm thick. It shall be brought to a true, even surface with the wooden straight edge.	
6.06.02		For external plaster, the plastering operations shall be started from the top and carried downwards. To ensure even thickness and a true surface, plaster about 15 x 15 cm shall be first applied horizontally and vertically, at not more than 2m intervals over the entire surface to serve as gauges. The surfaces of those gauged areas shall be truly in the plane of the finished plastered surface. For internal plaster, the plastering operations may be started wherever the building frame and cladding work	
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	are ready, the temporary supports of the ceiling resting on the wall have been removed. The first undercoat shall then be applied to ceilings. After the ceiling plaster is completed and scaffolding for the same removed, the first undercoat on walls shall then be applied. After a suitable time interval as detailed under Applications of plaster, the second coat (finishing coat) shall be applied, first to the ceilings and then to the walls. Where corners and edges have to be rounded off, such rounding off shall be completed along with the finishing coat to prevent any joint marks.			
6.06.03	Stage scaffolding shall be provided for ceiling plaster. This shall be independent of the walls. Ceiling plaster shall not be commenced until the slab above has been finished and centering has been removed. The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5 mm.			
6.06.04	Lathe Plaster and grading Underbed The lathe plaster shall be applied over the steel beams. Before plastering, the surface of metal type shall be brushed over with thin cement slurry or given a protective coat of bitumen oil paint. Plastering shall be carried out in two coats. Mortars for the first coat shall be of stiff consistency and applied as evenly as possible to give a uniform good cover to the lathing. It shall be allowed to dry until all shrinkage movement has ceased before the second coat is applied. Too much pressure shall not be used in applying plaster to lathing to guard against its deflection. Galvanised chicken wire mesh wherever specified (which is covered under separate item) shall be provided before lath plaster. Cement-Sand mortar grading underbed shall be provided upto an average thickness of 25mm. The underbed shall be laid to the specified slope.			
6.06.05	Drip Course Drip course wherever indicated in the drawings shall be provided at the time of plastering to prevent travelling of water drops from the projections. Unless otherwise, specified, projected strip form drip course shall be provided. This shall be apart of plaster.			
6.07.00	Curing Each undercoat shall be damp cured for atleast 2 days and kept damp continuously till the next coat is applied. The final plastered surface shall be cured and kept continuously damp for minimum 7 days.			
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7.00.00	GROOVES IN PLASTER Where specified in drawings, rectangular grooves 12 X 12 mm upto 20 x 15 mm deep shall be provided in external plaster by means of timber battens or metal strips, fixed on plaster when plaster is still green. Battens or strips shall be carefully removed after initial set of plaster and broken edges and corners made good. All grooves shall be uniform in width and depth and shall be truly plumb and correctly aligned.		
8.00.00	GALVANISED WIRE MESH The galvanised chicken wire mesh shall be 0.9 mm thick as per IS : 3150 and of mesh size as specified in schedule of items. This shall be secured with 0.90 mm tying wire. Edges of lathing (wire mesh) shall be lapped not less than 25 mm at the sides and ends and wired together with galvanised wire of diameter not less than 1.25 mm, every 100 mm between supports.		
9.00.00	WALL PUTTY Wall putty is a polymer based water resistant putty for concrete/ walls and ceilings. Wall putty shall be mixed with water to a workable consistency and shall be applied on the plastered surface as per guidelines & recommendations of the manufacturer. The finished surface shall be smooth and durable surface suitable for all kinds of paint. Minimum two coats (2mm) shall be applied to obtain smooth surface.		
10.00.00	FINISH PAINT		
10.01.00	General Requirements		
10.01.01	This covers the finish painting of all types of concrete surfaces and / or plastered masonry/ concrete surfaces in all kinds of work.		
10.01.02	Before commencing painting / finishing, the Contractor shall undertake normal precautions to prevent damage, disfiguration or staining of the painting / finishing by other trades and also damage, disfiguration or staining to work of other trades / activities or other installations.		
10.01.03	Paints shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken against fire hazards.		
10.02.00	Materials All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied. All colours shall be as per painting/finish schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, these shall be executed in advance with the specified materials for the approval of the Engineer. Paint in general shall have eco-friendly low VOC contents, complying with Green Building/ GRIHA norms.		
10.02.01	Acrylic Distemper		
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		Acrylic Distemper shall be applied (wherever specified) on the plastered surface. The paint shall be applied on the dry surface as per guidelines & recommendations of the manufacturer of the paint. Minimum three coats shall be applied to obtain even shade.	
10.02.02		Acrylic Emulsion Paint	
		Acrylic emulsion paint shall be water based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigment and fungicide conforming to IS: 5411 (Part - 1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering the paint. After it is dried, the paint should be able to withstand washing with mild soap and water without any deterioration in colour or without showing flaking, blistering or peeling.	
10.02.03		Chemical Resistant Paint (Chlorinated Rubber Paint)	
		Chlorinated Rubber Paint shall be made from natural rubber and chlorine. For finishing coat, suitable colour pigment shall be added. The material shall be hard resin and shall be plasticised to make elastic paint films. Stabilisers shall be added for exterior use to prevent deterioration by ultra-violet light. For primer, chlorinated rubber zinc phosphate shall be used. Titanium dioxide/ micaceous iron oxide shall be used for intermediate coat.	
10.02.04		Oil Resistant Paint	
		Oil resistant paint shall be epoxy based. Primer coat shall be as per manufacturer's specifications.	
10.03.00		Preparation of Surface	
10.03.01		Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness and readiness of the surface to be painted on.	
10.03.02		Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry / plaster cracks shall be cleared out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaced area shall be treated with minimum one coat of cement primer which should be continued to the surrounding area for a distance of minimum 100 mm.	
10.03.03		Wherever specified, the concrete / plastered surface shall be finished with 2 mm thick wall putty finish to give an even and smooth surface, before the application of finishing paint/ coat. Acrylic emulsion paint shall be applied over the surfaces finished with wall putty, as required. Acrylic distemper shall also be generally applied (wherever possible) over the surfaces finished with wall putty, if required.	
10.04.00		Application	
10.04.01		Application shall generally be by brush. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades	
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		and prepare test panels of minimum size 1 metre square as per instruction of the Engineer and obtain his approval prior to application of finishing paints. 10.04.02 Proper tools and implements shall be used. Scaffoldings if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes. 10.04.03 Painting shall be done by skilled labour in a workmanlike manner. All materials shall be evenly applied, so as to be free of sags, runs, crawls or other defects. All coats shall be of proper consistency. 10.04.04 All coats shall be thoroughly dry before being sand papered or before the succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specified number of coats, further coats shall be applied by the Contractor when so directed by the Engineer. 10.04.05 All undercoats shall be tinted to approximate the colour of the finishing coats. Finishing coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish. One coat shall consist of horizontal strokes immediately followed by vertical ones. 10.04.06 EXTERIOR PAINTING ON WALL The paint shall be (premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in- Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge. Preparation of Surface For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced. Application of Base Coat Base coat shall be of water proofing cement paint. Preparation of Mix for Base Coat Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise			
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of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere. Application of Base Coat The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade. Precaution Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement. Application of exterior paint Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-charge shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.				
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11.00.00	SHEETING WORKS				
11.01.00	General Requirement				
	This part of the specification covers the technical requirements of colour-coated sheet and allied works for roofing, decking and cladding, with or without thermal insulation. Supply and installation of the profiled sheeting shall be done by same agency. During handling / stacking, if any damage is done to sheets like distortion of edges, formation of dents, scratches on sheet etc., then such damaged sheet shall stand rejected and shall be immediately replaced by the contractor.				
11.02.00	Material				
11.02.01	Wall Cladding & Roofing Material				
	Troughed permanently colour coated sheet of approved shade and colour shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade YS250 as per IS 15961 / grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade YS350 as per IS 15961 / grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade YS550 as per IS 15961 / grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 Alternatively, aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS: 1254. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided. Bidder to ensure that same profile is to be used throughout the package for all facilities to maintain uniformity.				
11.02.02	Metal Deck Roof Material				
	Troughed permanently colour coated metal decking sheets shall be i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275.				
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11.05.00	Fasteners	For metal deck sheets used for roofing (without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.			
		Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self- drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. Shear anchor studs shall also be provided through metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams as specified in Clause no. 8.03.00. Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.			
11.06.00	Miscellaneous Details	To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing. Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non-stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer. For insulation of cladding and other areas, mineral wool conforming to IS 8183 shall be used. The density shall be 32 or 48 kg. /cu.m for glass or rock wool respectively. The nominal thickness of insulation shall be 50mm.			
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All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer. The contractor shall prepare working drawings of sheeting system including end and side laps, flashing, fixing details etc. before starting sheeting work at site.					
11.07.00	Pre-Fabricated Insulated Metal Sandwich Panels For buildings where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade. Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.				
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS			
11.08.00	Polycarbonate Sheets The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details.				
11.09.00	Plain permanently colour coated steel metal sheet for ridge and hips, flashings, trimmings, closure for vertical and horizontal joints, capping etc shall confirm to the same requirements as those of troughed permanently colour coated metal sheet for roofing and side cladding.				
11.09.01	a) For metal decking the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 over a span of 1.7 m under total super imposed loading (DL +LL) of 450 kg per Sq.M. for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS: 801 for satisfying the deflection and strength requirements. All structural calculations for checking the adequacy of the profiled sheet for strength & deflection criteria is to be done taking into consideration the maximum permissible negative tolerance over the specified BMT. b) For metal roofing and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 over a span of 1.5 m under design wind pressure of 160 kg/sq.m. for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS:801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition. All necessary structural calculations for checking the adequacy of the profiled sheet for strength & deflection criteria is to be done taking into consideration the maximum permissible negative tolerance over the BMT. c) In case, during the inspection, if it is observed that the BMT of sheet / coil is having (-)ve tolerance beyond 0.04mm i.e. if minimum BMT of sheet is found to be less than the "Lower Limit of BMT", it will be rejected.				
11.09.02	The maximum spacing of the fasteners shall be 390 mm c/c along the length of purlins / runners. However exact spacing shall be as per the design done by the bidder for the fasteners considering the wind load, self-load and other associated loads. Minimum diameter of the fastener shall be 5.5 mm and at least 3 nos. of fasteners shall be used per sheet.				
11.09.03	Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non-staining material and be flexible enough not to interface with fit of the sheets.				
11.09.04	Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.				
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS			
11.09.05		For insulation of cladding and other areas, mineral wool conforming to IS: 8183 shall be used. The density shall be 32 or 48 kg. /Cu.M. for glass or rock wool respectively. The nominal thickness of insulation shall be 50mm.			
11.09.06		Special coated fasteners shall be used conforming to class 3 as per AS3566 and shall be tested to 1000 hours salt spray test.			
11.09.07		Data Sheet for Metal Decking and Metal Cladding shall be submitted as per the formats given in the Annexure-1 & 2.			
11.10.00		Installation and Fixing			
11.10.01		Metal Decking			
		a) The sheeting shall be fixed as per the working drawings. Sheets shall be supplied in required sizes (based on purlin spacing) according to the cutting schedule. Generally cutting of sheets to length shall not be permitted at site. Specific approval under exceptional circumstances shall be obtained before cutting of any sheet at site. Power tools shall be used for cutting. Cutting and trimming of small openings which were not finalised at the time of working drawings can be allowed at site. Wherever possible, site cut edges shall be concealed at laps or with flashings. Suitable steel members for stiffening shall be provided at the cut edges. No gas cutting shall be done on the sheet. If any sheet is found with gas cut mark, same shall stand rejected and shall be immediately replaced.			
		b) Distorted, blemished or water stained sheets shall not be used.			
		c) Before installing decking sheet, it shall be ensured that the purlins are in true planes, correctly placed and securely fixed.			
		d) Side and end laps of the sheets shall be made weather proof by securing them with the fasteners not less than 4.0mm diameter with 2.0 mm thick neoprene washer. Maximum spacing of the fasteners should not exceed 500 mm.			
		e) Precautions shall be taken during the erection of the sheets to ensure that partially erected decking sheets are protected during inclement weather and damage at all times.			
		f) Side and end of decking sheet shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind.			
		g) Length of the sheet shall be such as to cover minimum 3 span purlin spacings.			
		h) The roof decking sheets shall be fixed to the purlins with the help of self drilling and tapping type fasteners and neoprene washers.			
		i) Sheets shall be laid over the supporting purlins with a minimum bearing of 50 mm and end projection of 75 mm at lap joints.			
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS			
		j) End and side laps between the sheets shall be sufficiently large to ensure the weather tightness. In no case, the end laps shall be less than 150 mm and side laps less than one trough length with proper weather tight arrangement.			
11.10.02		Roofing and cladding a) The sheeting shall be fixed as per the working drawings. Sheets shall be supplied in required sizes (based on purlin spacing) according to the cutting schedule. Generally cutting of sheets shall not be permitted at site. Specific approval under exceptional circumstances shall be obtained before cutting of any sheet at site. Power tools shall be used for cutting. Cutting and trimming of small openings which were not finalised at the time of working drawings can be allowed at site. Wherever possible, site cut edges shall be concealed at laps or with flashing. Suitable steel members for stiffening shall be provided at the cut edges. No gas cutting shall be done on the sheet. If any sheet is found with gas cut mark, same shall stand rejected and shall be immediately replaced. b) Distorted, blemished or water stained sheets shall not be used. c) Before installing roofing/cladding, it shall be ensured that the supporting structure i.e. purlins/runners are in true planes, correctly placed and securely fixed. d) Side and end laps of the sheets shall be made weather proof by securing them with the fasteners not less than 4.0mm diameter with 2.0 mm thick neoprene washer and cap of matching colour. Maximum spacing of the fasteners should not to exceed 500 mm. e) Precautions shall be taken during the erection of roofing/ cladding to ensure that partially erected roofing/cladding and insulation (pending placing of external cladding sheet) are protected during inclement weather to prevent the ingress of water and damage at all times. f) During erection of roofing/cladding, ladders shall not be leaned on any cladding without precautions being taken against damage. g) The fasteners shall be installed by means of power tools and provided with neoprene seal. h) Length of the sheet shall be such as to cover minimum 3 span purlin spacings. i) Expansion joints shall be provided to take care of movements due to temperature variations. j) The sheets shall be laid on the steel purlins/runner or scantlings to a true plane with the lines of profiles truly parallel to or normal to other sides of the area to be covered, unless otherwise required as in special shape.			
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS	
		k) Cladding erection for each elevation shall commence at the bottom and proceed towards the top, in order to ensure tight fitting laps. l) The sheets shall be laid with a minimum overlap of 15 cm at the ends and side laps shall be of one trough length subject to a minimum of 50 mm, having a proper water tight arrangement. The minimum lap of sheets with ridges, hips and valleys shall be 15 cm measured at right angles to the line of the ridge, hip and valley respectively. m) In case of insulated sheeting works, the insulation shall be provided. n) In case double skin cladding, inner sheet and outer sheet can be directly fixed to the opposite faces of the sheeting runner totally concealing the supporting steel structure. o) Crimping and curving wherever specified shall be provided over the profile sheet.	
11.10.03		Flashing, trimming etc. Flashings, cappings, trimming, closure for vertical/horizontal joints, ridge and hips etc. shall be provided with a minimum lap of 15 cm. The lapping of sheets shall provide the dust free, airtight enclosure. If required this may be achieved by using 2- parts polysulphide sealing compound or butyl tape. Aprons, closures, flashings and other similar fittings shall be formed at works before delivery to site. Site forming or dressing of these items will be approved only in special locations. The black synthetic rubber external trough fillers are to be secured by the mechanical fixings to the flashings or parapet capping.	
11.10.04		Measurements This clause shall be read in conjunction with the clause for the measurements given in Part-A of the specifications. a) Light gauge troughed permanently colour coated metal decking shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However, no deductions shall be made for openings upto 0.4 Sq.M. each in area. b) Troughed permanently colour coated sheet on roof, sides etc. shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However no deductions shall be made for openings upto 0.4 Sq.M. each in area. c) Crimping and curving shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However, no deductions shall be made for openings upto 0.4 Sq.M each in area. d) Plain permanently colour coated sheet for ridge and hips, flashing/trimming/closure for vertical/horizontal joints etc. shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However, no deductions shall be made for openings up to 0.4 Sq.M. each in area.	
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS			
12.00.00	INSULATION				
12.01.00	General Requirements				
12.01.01	This part of the specification covers the technical requirements for providing, laying, installation and preparation of working drawings for under deck thermal insulation.				
12.02.00	Material				
12.02.01	Mineral Wool				
	This shall be upto 50mm nominal thickness having a density of 32 kg/m3 for glass wool and 48 kg/m3 for rock wool conforming to IS 8183.				
12.02.02	Polyisocyanurate / rigid phenolic foam				
	This shall be preformed rigid polyisocyanurate (PIR) foam conforming to IS 12436 or rigid phenolic foam, conforming to IS 13204. These shall be in the form of boards, slabs, etc. The material shall be fire retardant and non-toxic, having negligible smoke generation property. The density of the material shall be 32 kg/ Cu.m. Nominal thickness of the slab shall be 30mm. The nominal size of the slab shall not be less than 1m x 0.5m.				
12.03.00	Installation and fixing				
12.04.00	Mineral wool insulation				
	The method used for securing insulation slabs prior to the erection of the cladding sheets, shall be to the approval of the Engineer. For insulated metal cladding, cold applied adhesive shall be applied as per manufacturer's recommendations. In addition, for securing the insulation in position galvanised hexagonal wire netting of not less than 0.3 mm diameter and 19 mm mesh size shall be used. Wherever specified (e.g. metal false ceiling) insulation shall be wrapped in polythene sheet bags. The insulation shall be provided with or without framed strips as specified. Framed strips shall be of mild steel and made of flat of size 25 x 3mm minimum and placed at maximum spacing of 300mm c/c to hold the insulation between the horizontal sheeting runners. The under-deck insulation wherever specified shall be provided with 0.05mm thick aluminium foil and 0.56 mm diameter and 25mm mesh size GI wire netting. The under-deck insulation shall be fixed below RCC slab by using metal expansion fasteners.				
12.04.01	Polyisocyanurate phenolic foam				
	Before application of the insulation slab, the bottom surface shall be cleaned of dust and loose particles with the help of brush. The adhesive glue shall be applied both on the underside of the slab as well as on the top of the insulation slab as per manufacturer's recommendations and the slab shall then be pressed in position when the glue is still tacky. The ends of the slab shall be glued and butted together. The exposed face of the slab shall be laminated with 0.05mm thick aluminium foil. Further these slabs shall be secured by providing galvanised mild steel fasteners. The maximum spacing of the fasteners shall be 450 mm c/c.				
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS	
13.00.00	SAMPLING, TESTING, ACCEPTANCE CRITERIA INCLUDING CONSTRUCTION TOLERANCES		
13.01.00	Frequency of sampling, testing and quality assurance including the method of conducting the tests, acceptance criteria and construction tolerances shall be as given in Part-C of this specification.		
14.00.00	RATES AND MEASUREMENTS		
14.01.00	Rates This clause shall be read in conjunction with the clause for the unit rate given in Part-A of this specification. i) There shall not be separate unit rates for DPC, plinth protection as these are covered under different item of the schedule of item. ii) There shall not be a separate unit rate for drip course, lath plaster, plaster for grading underbed as these are included in the item of plastering. iii) The rate for dismantling of brick masonry shall also provide for removing mortar from and cleaning bricks, cutting of reinforcement bars, stacking, cleaning and straightening of reinforcement bars from reinforced masonry work. iv) The rate for metal sheeting work (decking, roofing, cladding, flashings etc.) also provides for provision of metal sheet of thickness higher than the minimum specified value in order to meet the required sectional properties		
14.02.00	Measurements This clause shall be read in conjunction with the clause for the measurements given in Part-A of this specification.		
14.02.01	a) Brickwork masonry shall be measured by volume in Cu.m. Reinforcement if any provided in masonry work shall be paid separately according to items of reinforcement work. RCC in bands shall be measured and paid separately under the item of concreting. Full deduction for volume of RCC in bands shall, however, be made from the measurement for masonry work. For masonry work, no deductions shall be made nor any extra payment made for the following: i) Opening upto 0.1 Sq.M. each in area. In calculating the area of the openings any separate lintels or sills shall be included along with the size of the openings but the end portions of the lintels shall be excluded and the extra width of the rebated reveals, if any, shall also be excluded. ii) Drainage holes and recesses for cement concrete blocks to embed hold fasts for doors, windows etc. iii) Necessary holes/recesses etc. for embedded fixtures and pipes upto 300mm diameter. Nothing extra shall be paid for the mortar used for fixing these fixtures and pipes. iv) Forming chases in masonry each up to a section of 350 sq.mm. v) Voids within the concrete blocks.		
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Clause No.		MASONRY, SHEETING AND ALLIED WORKS	
b) Dismantling of masonry work shall be measured in Cu.m. While measuring thickness of plastered walls, the thickness of plaster shall be ignored. Measurements of all work, except hidden work, shall be taken before dismantling and no allowance for increase in bulk shall be allowed. Stipulations for deduction of voids, openings etc. shall be on the same basis as that employed for masonry construction. c) All cement : sand plaster shall be measured net (on the surface area on which it is applied) in square meters except for mortar used for grading underbed over floors/roofs and lath plaster which shall be measured in Cu.m. Plastering of different proportion and thickness shall be measured separately. d) Groove in plaster and formation of drip course shall be part of the plaster and no separate measurement shall be taken for the same. e) Galvanised hexagonal wire netting shall be measured net (on the surface area on which it is applied) in Sq.m. f) Wall putty shall be part of the finish items and (no) separate measurement shall be taken for the same. g) Finish paint over concrete / masonry surfaces shall be measured net (on the surface area on which it is applied) in Sq.m. h) i) Ready mix two component, resin and polymer bonded granular textured coating finish shall be measured net (on the surface area on which it is applied) in Sq.m. ii) Wash stone grit plaster shall be measured net (on the surface area on which it is applied) in Sq.M. i) Light gauge troughed permanently colour coated metal decking shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However no deductions shall be made for openings upto 0.4 m2 each in area. j) Troughed permanently colour coated sheet on roof, sides etc. shall be measured net as laid in Sq.M. without any allowance for laps and troughs. However, no deductions shall be made for openings upto 0.4 Sq.m. each in area. k) Crimping and curving shall be measured net as laid in Sq.m. without any allowance for laps and troughs. However no deductions shall be made for openings upto 0.4 Sq.m. each in area. l) Plain permanently colour coated sheet for ridge and hips, flashing/trimming/closure for vertical/horizontal joints etc. shall be measured net as laid in Sq.m. without any allowance for laps and troughs. However no deductions shall be made for openings upto 0.4 Sq.m. each in area. m) Insulation shall be measured in Cu.m. Area of insulation actually provided shall be measured and shall be multiplied by measured thickness for computing the volume. n) Aluminium foil including galvanised wire netting for covering of under deck insulation shall be measured net as laid in Sq.m. without any allowance for laps. o) Polyisocynurate, or rigid phenolic foam, underdeck insulation and wall insulation shall be measured net as laid in Sq.m. without any allowance for laps and troughs. However, no deductions shall be made for openings up to 0.4 m2 each in area.			
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ANNEXURE-ISTANDARD DATA SHEET FOR METAL DECKING SHEET

Project Name: _____ Package Name: _____
 Document No. _____ Rev No. _____ Rev Date: _____

1. Brief Description: Color coated metal deck as per Schedule of Item No. 45
2. Source/ Manufacturer of sheet : As per MQP
3. Name of profiler : As per MQP
4. Material Specification : Refer Decking Requirements as per Table-1.

a)	Material Group (Select any one and strike others)	Group 1a	Group 1b	Group 1c	Group 2a	Group 2b	Group 2c	Group 3a	Group 3b	Group 3c
b)	Grade / Reference code	As per Decking Requirements Table-2 for the corresponding selected Material Group.								
c)	Yield strength(minimum)									
d)	Tensile strength(minimum)									
e)	Elongation %									
f)	Coating Class									
g)	Bare Minimum Thickness in mm									
h)	Tolerance on BMT									

(Signature of Contractor)

5. Painting System: Select SMP or Polyester Paint conforming to Product type 4 as per AS/NZS 2728: 1997

Coat DFT (Dry film thickness)	Exposed Side	Unexposed side
Primer	5 microns (Nominal)	5 microns (Nominal)
Main	20 microns (Nominal)	5 microns (Nominal)
Sub- Total	25 microns (Nominal)	10 microns (Nominal)
Total	35 microns (Nominal)	

6. Test Requirements: As per MQP
7. Profile: Refer Drg No. _____ Rev No. ____ Titled _____
(Attach approved drawing).
8. Colour Shade: RAL 9002 on exposed surface.
9. Organic Film: Transparent Organic film of thickness 40 microns on outer surface.
10. Storage Requirement: on wooden sleepers and covered.

(Signature of Contractor)

ANNEXURE-II

STANDARD DATA SHEET FOR METAL CLADDING SHEET

Project Name: _____ Package Name: _____
 Document No. _____ Rev No. _____ Rev Date: _____

1. Brief Description: Color coated metal deck as per Schedule of Item No. 46
2. Source/ Manufacturer of sheet : As per MQP
3. Name of profiler : As per MQP
4. Material Specification : Refer Decking Requirements as per Table-1.

i)	Material Group (Select any one and strike others)	Group 1a	Group 1b	Group 1c	Group 2a	Group 2b	Group 2c	Group 3a	Group 3b	Group 3c
j)	Grade / Reference code	As per Decking Requirements Table-2 for the corresponding selected Material Group.								
k)	Yield strength(minimum)									
l)	Tensile strength(minimum)									
m)	Elongation %									
n)	Coating Class									
o)	Bare Minimum Thickness in mm									
p)	Tolerance on BMT									

(Signature of Contractor)

5. Painting System: Select SMP or Polyester Paint conforming to Product type 4 as per AS/NZS 2728: 1997

Coat DFT (Dry film thickness)	Exposed Side	Unexposed side
Primer	5 microns (Nominal)	5 microns (Nominal)
Main	20 microns (Nominal)	5 microns (Nominal)
Sub- Total	25 microns (Nominal)	10 microns (Nominal)
Total	35 microns (Nominal)	

6. Test Requirements: As per MQP
7. Profile: Refer Drg No. _____ Rev No. __ Titled _____
(Attach approved drawing).
8. Colour Shade: RAL 5012, 5005, 9002, etc. (on exposed surface) as per relevant approved Architectural Drawings.
9. Organic Film: Transparent Organic film of thickness 40 microns on outer surface.
10. Storage Requirement: on wooden sleepers and covered.

(Signature of Contractor)

Clause No.		FINISHING AND ALLIED WORKS			
SECTION-5					
FINISHING AND ALLIED WORKS					
1.00.00	GENERAL REQUIREMENT				
1.01.00	Content				
1.01.01	This section of the specification covers the technical requirements for floor finish and allied works, doors, windows, partitions, glass and glazing, water proofing, false ceiling, fencing, gates and other similar works at all levels, for all types of works and for all kinds of working conditions.				
1.01.02	The plastering and painting on masonry & concrete surfaces and painting of structural steel have been covered elsewhere in this specification.				
1.02.00	Codes and Standards				
1.01.03	Some of the relevant applicable Indian Standards and codes, etc, (latest Edition) applicable to this section of the specification are listed below:				
	IS : 158	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali and heat resisting			
	IS : 419	Putty, for use on window frames			
	IS : 513	Cold rolled carbon steel sheets			
	IS : 702	Specification for industrial bitumen			
	IS : 733	Specification for wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes)			
	IS : 1079	Hot rolled carbon steel sheets and strips IS : 3043Code of practice for earthing			
	IS : 1081	Code of practice for fixing and glazing of metal (Steel and aluminium) doors, windows and ventilators			
	IS : 1161	Steel tubes for structural purposes IS : 1237 Cement concrete flooring tiles			
	IS : 1285	Wrought aluminium and aluminium alloy extruded round and hollow section (for general engineering purposes)			
	IS : 1443	Code of practice for laying and finishing of cement concrete flooring tiles			
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Clause No.		FINISHING AND ALLIED WORKS		
IS : 1580		Specification for bituminous compound for water-proofing and caulking purposes		
IS : 1948		Specification for aluminium doors, windows and ventilators		
IS : 1949		Specification for aluminium windows for Industrial buildings		
IS : 2062		Steel for general structural purposes		
IS : 2095 (part I)		Specification for gypsum plaster boards: plain gypsum plaster boards		
IS : 2095(part III)		Specification for gypsum plaster boards: reinforced gypsum plaster boards		
IS : 2202		Wooden flush door shutters (solid core type) particle board face panels and hard (part-2) board face panels		
IS : 2395		Code of practice for painting concrete, masonry and plaster surfaces		
(Part-1)		Operations and workmanship		
(Part-2)		Schedule		
IS : 2571		Code of practice for laying in-situ cement concrete flooring		
IS : 3067		Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings		
IS : 3548		Code of practice for glazing in buildings		
IS : 3614		Specification for fire check doors:		
(part-1)		Plate metal covered and rolling type		
(part-2)		Resistance test and performance criteria		
IS : 4351		Specifications for steel door frames		
IS : 4441		Code of practice for use of silicate type chemical resistant mortars		
IS : 4443		Code of practice for use of resin type chemical resistant mortars		
IS : 4457		Specification for ceramic unglazed vitreous acid resisting tile		
IS : 4832(part I)		Specification for chemical resistant mortars: silicon type		
IS : 4832(part II)		Specification for chemical resistant mortars: resin type		
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Clause No.		FINISHING AND ALLIED WORKS				
		IS : 4832(part III)	Specification for chemical resistant mortars: sulphur type			
		IS : 5437	Figured, rolled and wired glass			
		IS : 6248	Specifications for metal rolling shutters and rolling grills			
		IS : 8042	White portland cement			
		IS : 15622	pressed ceramic tiles			
		IS : 13801	Chequered cement concrete tiles-Specification			
		IS : 14900	Transparent Float glass – Specification			
		IS : 15658	Precast Concrete Blocks for Paving - Specification			
		ASTM	Standard specifications for high solid content cold liquid applied elastomeric water C836-89a proofing membrane for use with separate wearing course			
		ASTM898-89	Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.			
		BS:6717 Part IV	Pre cast concrete paving blocks.			
		BS:7533 Part III	Guide for structural design of pavements constructed with clay or concrete block pavers.			
1.03.00 Sequence						
Commencement, scheduling and sequence of the finishing works, shall be planned in detail keeping in view the activities of other agencies working in that area and must be specifically approved by the Engineer. However, the Contractor shall remain fully responsible for all normal precautions and vigilance to prevent any damage to finishing items whatsoever till handing over. Size and thickness of the topping/ tile shall be as specified as the schedules of items.						
1.04.00 Materials						
A) All materials shall be of 1 st quality.						
B) For colour and shade, RAL nomenclature and the classification shall be followed.						
C) Wherever working drawings are involved, the procurement of the material shall be done only after the preparation of working drawings including data sheets and approval of same by Engineer. All bought out items shall be procured from approved sub vendor as mentioned in part of this specification.						
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Clause No.		FINISHING AND ALLIED WORKS		
1.05.00	Workmanship Workmanship shall be as recommended by manufacturer (supplier of material) and approved by Engineer. Workers specially experienced in particular items of work shall only be engaged under the supervision of experienced supervisors recommended / appointed by the manufacturer.			
1.06.00	Handling & Transportation All bought out items shall be protected, covered, boxed and crated properly before despatch so that there will be no damage / deterioration during transportation, handling and storage at site till such time they are fixed in position. All materials shall be stored, dry in the covered shed / place over wooden sleeper with a stacking height not to exceed 2m.			
1.07.00	Working Drawings Contractor shall prepare the detailed working drawings / data sheets for all bought out items, etc based on the scheme drawing/dimensions given by the Engineer. Working drawing / data sheets shall indicate the schedule of all hardware (fittings and fixture), fabrication details along with the section sizes, fixing details, bill of materials along with sectional weight and total weight, net area, numbers required, dimensions, material specification along with quantity for each type of material, reference to the applicable codes and standards, method of installing, workmanship, tolerance, acceptance criteria, etc.			
2.00.00	FLOOR FINISH AND ALLIED WORKS			
2.01.00	General Requirement			
2.01.01	This part of the specification covers the requirements for providing, laying, installation, preparation of working drawings, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes including skirting / dado and allied items of work.			
2.01.02	Generally following type of finishes shall be provided over the required under bed / compacted earth sub base / hard stone aggregate sub base. i) Vitrified tiles (mirror polished and matt finished) ii) Concrete hardener topping iii) Heavy duty cement concrete tiles iv) Interlocking concrete blocks v) Neat cement slurry finish vi) Natural stone like marble, granite vii) Pre-polished, high wearing resistance concrete tiles vii) Acid / alkali resistant tiles.			
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Clause No.		FINISHING AND ALLIED WORKS	
	ix)	Dust pressed ceramic tiles.	
	x)	Chequered tiles	
	xi)	Designer ceramic wall tiles	
2.01.03	Pigment		
		Good quality pigment having durable colour shall only be used. Organic colour and lead pigments shall not be used. The colour pigment as selected shall be pure mineral pigments, lime proof and non-fading. Matching of colour between different batches shall be ensured.	
2.02.00	Materials		
2.02.01		Material shall be from approved manufacturer / agency and installed by specialist agency.	
2.02.02		All cements used for laying the floor topping /tiles shall be Ordinary Portland cement in accordance with IS: 8042 unless specified otherwise. For jointing and joint filling, grey/ white cement suitably colour pigmented with the colour matching the colour shade of topping/tiles or pointed neatly with 3x4mm SS grout SP-100 of Laticrete or approved equivalent in approved colour to match the colour of the tile shall be used.	
2.02.03		Tile shall be of best & approved quality, color size and shape and shall be laid to as per approved pattern. Tiles shall be of uniform color, true to size & shape and free from defects. Flooring tiles shall be laid as per pattern over 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand).The joints shall be finished neat with cement pigmented to tile shade or pointed neatly with 3x4mm SS grout SP-100 of Laticrete or approved equivalent in approved colour to match the colour of the tile. Tiles on dado or vertical surfaces shall be fixed over 12 mm thick cement mortar 1:3 (1 cement: 3 coarse sand). Vitrified ceramic tile shall be homogeneous and compact throughout the entire body and fully vitrified. The minimum Flexural strength shall be above 27N/sq.mm as per ISO:13006 / EN 176 and MOH hardness not less than 6. The size of the tiles shall be as specified. Tiles shall be mirror polished. Dust pressed ceramic tiles for flooring shall conform to IS: 15622. Tiles shall be (equivalent to Grade V) matt finish in approved colour and design. Tiles shall be homogeneous and compact throughout the entire body. The size of tiles shall be as specified.	
2.02.04		Concrete hardener compound shall be of approved quality consisting of uniformly graded, properly treated, iron particle, free from non-ferrous metal particle, oil, grease, sand, soluble alkaline compound or other injurious materials. Wherever desired by the Engineer, the sample shall be tested for abrasion value.	
2.02.05		IS: 1237 shall be followed as general guidance for the specification of heavy	
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		duty cement concrete tiles. Top wearing shall be with white cement with pigment. Aggregate shall be of hard stone chips of different colours. Carborundum, granite, quartzite chips shall be used. Properly graded aggregate upto 10 mm size shall be used. Physical properties and dimensional tolerance of the tile shall be as per IS: 1237. However, surface hair cracks shall not be acceptable. Tile shall be initially grind (preferably twice) before laying.	
2.02.06		Interlocking blocks shall generally meet the requirements of IS: 15658/ BS:6717 (Part-I). The blocks shall be factory made and machine moulded. The minimum grade of concrete shall be M-35. A suitable pigment shall be added to give the required colour shade. The shape of blocks shall be irregular but other than cuboids as approved by Engineer. The nominal thickness of blocks shall be 60 mm. However, blocks of other thickness i.e. varying from 40mm to 100mm may also be used depending upon functional requirement. The shape may be different for different areas of work with different pattern in indentation for guiding band for visually impaired persons.	
2.02.07		For finishing the concrete/mortar surface topping with ordinary gray neat cement, IS: 2571 shall be followed as general guidance.	
2.02.08		DELETED	
2.02.09		Natural Polished Stone Slab (Marble, Granite, Cudappah/ kota) shall be used as finishing material for both horizontal and vertical surfaces. The slab shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. The slab shall be machine cut to requisite thickness and size. The slabs shall have the top (exposed) face mirror polished/matt finished before being brought to site. The slabs shall conform to the size required. All corners and edges of the slab are true, square and free from chapping and the surface shall be true and plane. Rajnagar Marble shall be plain white marble with coarse grain pre dominantly showing mica particles giving reflection in bright light.	
2.02.10		Designer ceramic wall tiles of specified size, including pointing the joints with white cement mixed with matching pigment.	
2.02.11		Cement concrete chequerred tiles for pathway for maintenance jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and cleaning.	
2.02.12		DELETED	
2.02.13		Flame Finish Granite Granite stone slab shall be machine cut to required size & shape, with free edges. Granite stone shall be flame finished as specified & the flame finish shall be smooth with dull finish without any flaws or waviness and without any visible chisel mark on the surface.	
2.02.14		Decorative / designer pre polished, pigmented, high wearing resistance, concrete tiles shall have a compressive strength of 550 kg. / Sq.Cm., self cleaning, chamfered joint, functional recess, high elegance and aesthetic value. The tile shall have different inter locking pattern for different areas. Wherever specified tiles shall have anti skid arrangement. Tiles shall conform to	
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Clause No.		FINISHING AND ALLIED WORKS	
		IS: 1237 for heavy duty tiles.	
2.02.15		Acid/alkali resistant treatment shall be provided on horizontal and vertical surfaces including preparation of surfaces, application of one coat of primer conforming to IS:158 and a bitumastic layer conforming to IS:9510 on prepared surface, laying of acid resistant tiles as specified elsewhere with minimum 6 mm thick underbed of potassium silicate based mortar conforming to IS:4832 (Part I), raking of joints, acid curing and filling the joints with acid/alkali resistant epoxy/furane mortar conforming to IS:4832 (Part II) upto a depth of 20 mm, bitumastic end sealing complete.	
2.03.00		Under bed The under bed for flooring (horizontal surface) shall generally be with PCC of grade M-20 using 12.5 mm nominal size graded aggregates. For some type of flooring compacted earth sub base / hard stone aggregate sub base shall be used as under bed.	
2.04.00		Topping Different types of topping shall be provided over under-bed and/or laid directly over the base surface. Before laying the topping, the grey cement slurry shall be spread at an average rate of 2.5 kg per Sq.M. unless specified other wise.	
2.05.00		Pattern a) Flooring shall be laid in the pattern as given in the working drawings. Border panel shall not exceed 600 mm in width and joints in the border shall be in line with panel joints. b) Generally, the flooring shall be cast in alternate panels for which flooring/dividing strip need not be provided. Panels shall be bound by angle sections or flats. These shall have same depth as the flooring. The flooring shall be completed in one operation to ensure uniformity of colour of all the panels. This shall be cured for a minimum period of 7 days.	
2.06.00		Laying	
2.06.01		Tiles shall be laid over under bed when the concrete / cement sand mortar (plaster) is still green. Grey cement slurry, unless noted otherwise, shall be spread, over the under bed for proper bonding. The tiles shall be washed and cleaned before laying, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tile. Joints shall be kept as thin as possible and not exceeding 1.5 mm and shall be straight. Jointing and joint filling shall be done with white cement slurry mixed with colour pigment to match with the shade of the tile or pointed neatly with 3x4mm SS grout SP-100 of Laticrete or approved equivalent in approved colour to match the colour of the tiles. The laying shall be done true to line, level, in flush butt but square jointing as per the approved pattern. Wherever specified in the drawing, 3x4mm SS grout SP-100 of Laticrete or approved equivalent in approved colour with matching colour shall be used for jointing of the Vitrified mirror polished/matt	
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		finished tiles.		
2.06.02		Surface of the flooring during laying shall be frequently checked with a straight edge (at least 2 m long), so as to obtain true surface with the required slope. The tile must be frequently cleaned with a wet sponge. All cement and other deposit shall be removed immediately.		
2.06.03		Where full tile or half tile can not be fixed, tile shall be machine cut from full tile to the required size and their edges rubbed smooth to ensure a straight and true joint.		
2.06.04		Tiles to be fixed on the floor adjoining the wall shall enter not less than 12 mm under the plaster, skirting or dado.		
2.06.05		After the tiles have been laid, surplus cement slurry that may have come out of the joint shall be cleared off to a depth of 4 mm and all dust and loose mortar removed and cleaned. Joint shall then be filled with white cement mixed with pigment to match with the shade/ colour of the tiles. Floor shall be cured for a minimum period of 7 days.		
2.06.06		a) The concrete hardener finish shall be 12 mm thick layer laid over under bedding. b) 1 Part of concrete hardener compound shall be mixed dry with 4 parts of grey cement by weight. To this mixture, 6 mm nominal size stone aggregates shall be mixed in the ratio of 1:2 (1 cement hardener mixture: 2 stone aggregate) by volume, and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete. c) The above mixture so obtained shall be laid in 12 mm thickness on the under bed concrete within 2 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. After the initial set has started, the surface shall be finished smooth true to slope with steel floats.		
2.06.07		d) a) For laying of heavy duty concrete tile, IS: 1443 shall be followed for general guidance. A thick layer of grey cement slurry @ 2.5 kg. /Sq.M. shall be spread over the under bed before laying of tiles. a) The Joints between the tiles shall be filled with white cement mixed with pigment matching with the shade/colour of the tile. The joint shall be filled on the same day or latest by next morning of laying of the tiles. b) Tiles shall be laid within a month of manufacture and polishing done a week after laying, as the tile surface, with passage of time, becomes very hard and extremely difficult to polish, resulting in a poor finish. c) Grinding shall be done as per recommendation of the manufacturer		
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		including use of special type of grinding stone. At least two additional grindings shall be done after laying, besides the initial grinding. Tiny pinholes shall be thoroughly grouted using a colour grout and shall be cured for at least two days before subsequent grinding. The tiles shall be cleaned with oxalic acid before polishing. For cleaning, oxalic acid shall be dusted over the surface, sprinkled with water and rubbed with hard woolen rags. The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean. Wax polish shall be applied over the cleaned dry surfaces			
2.06.08		For laying of interlocking concrete blocks, BS:7533 (Part-3) shall be followed as general guidance. The blocks shall be laid on firm and prepared sub-base. The slope shall be provided in the sub-base to maintain the required slope. The sub- base can be of compacted earth or hard stone aggregate depending upon the intensity of load and type of application. The periphery of the paved area shall be suitably edge restrained. The sub-base shall be sand sprayed keeping a thickness of 20 mm. The laying of paving shall be carried out according to the required pattern. The paved blocks shall then be vibrated with a vibrator to their final level. The sand shall be sprayed over the joints and with the help of vibrator the sand shall get into the joints.			
2.06.09		For designer Ceramic Wall tiles, ordinary gray neat cement finish shall be applied over green concrete or green plaster. The top surface of RCC / PCC/ plaster shall be cleaned and the laitance shall be removed and a coat of grey cement slurry at the rate of 3.3 Kg/ Sq.M. shall be applied for fixing the tiles.			
2.06.010		The ready mix non metallic hard granules shall be laid by spreading directly over concrete base when it is still green and finished smooth with steel trowel. Nominal rate of application of granules shall be 5 kg per Sq.M. or as specified.			
2.06.012		a) Natural stone (marble, granite, cudappah/ kota) slabs shall be laid in pattern in combination of different types, size and colour as shown in the drawings or as directed by the Engineer. The slab shall be laid over underbed when the concrete /plaster is still green. b) The slab shall be washed clean before laying. It shall be laid on top of under bedding, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. Joints shall generally be flush and filled with white cement mixed with pigment to match will the shade / colour of the stone. The flooring shall be cured for a minimum period of seven (7) days. c) Slight unevenness of the meeting of slabs shall be removed by fine chiseling and shall be finished smooth by machine/hand grinding with fine-grained carborundam stone. The stone slab shall be of cleaned with oxalic acid before polishing. For cleaning, oxalic acid shall be dusted over the surface, sprinkled with water and rubbed with hard woolen rags. The following day the floor shall be wiped with a moist rag			
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		and dried with a soft cloth and finished clean. Wax polish shall be applied over the cleaned dry surfaces. d) Wherever specified the top surface of the granite stone shall be made rough by burning / shot blasting.	
2.06.013		The decorative / designer pre-polished pigmented high wearing resistance concrete tile shall be laid over the under bed. Backside of the tile shall be wetted and laid by tapping gently with rubber or wooden mallet to obtain perfect level. The surface of the tiles shall be cleaned with wet sponge immediately after laying and it must be ensured that base mortar cement which squeezes through the joints, does not settle on the tile. Also ensure that the water used is not hard or brackish. The area shall not be used for 24 hours and the joints shall be filled with the mixture of white cement and desired colour pigment.	
2.06.014		Acid / Alkali resistant tiles shall be laid after the concrete surfaces have been cured for 28 days. The surface shall be levelled and free from dust, loose dirt, oil, grease, etc. All pot holes, uneven surface, cracks, crevices shall be repaired.	
3.00.00		DOORS, WINDOWS, PARTITION, ETC.	
3.01.00		GENERAL REQUIREMENT	
3.01.00		This part of the specification covers the requirement of steel door frame, solid core flush door shutters, decorative veneer panels, hollow metal steel doors, fire proof doors, aluminium works for door, windows, ventilators, partition, aluminium grills, rolling shutters, sliding shutters, etc.	
3.02.00		MATERIALS	
3.02.01		Cold rolled steel shall conform to grade 'O' of IS:513. All steel upto 1.6 mm thickness shall be cold rolled.	
3.02.02		Hardware and fixtures like hinges, jam, beed, screws, bolts, handles, stoppers, door closers, lockers, hold fasts, mastic caulking, fasteners, neoprene gaskets etc shall be able to withstand repeated use. Door closers shall conform to IS:3564. Heavy duty double acting floor springs where specified shall conform to IS:6315. These shall be suitable for door shutters weighing upto 125 kg and shall be hydraulically regulated. These shall be constructed of cast brass casting cover and shoe, gun metal piston player and all other parts of mild steel. All hardware shall be as per relevant IS codes.	
3.02.03		Aluminium sections for fabrication of doors windows, ventilators, partitions cover strips, floor dividing strips etc. shall be either extruded standard tubular and/or other sections conforming to IS:1285. The alloy used shall conform to IS:733. All aluminium works shall be anodized to minimum anodic coating of grade AC 15 and electro colour dyed as per IS 1868 and IS 11857	
3.02.04		The mastic for caulking (if required) shall be of best quality.	
3.02.05		Blades of steel louvers shall be made of mild steel plates. Frame for louvers shall be made with steel.	
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3.02.06		All material including doors, windows, ventilators, partitions etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.			
3.02.07		The Contractor shall bring to the site the mastic cement in original sealed container of manufacturer and shall apply it as per the instructions, for all frames supplied by the Contractor and caulking done properly.			
3.03.00		Steel door frames			
3.03.01		The steel door frames for wooden or other non-metallic door shutters shall be pressed or cold rolled. The pressed steel frames shall conform to IS: 4351. Mild steel sheet of 1.25 mm (minimum) thickness shall be used for manufacturing of the frame. The profile of the frame shall be type-A, unless otherwise specified. The frame shall be fitted with hold fasts and/or expansion fasteners. Steel surfaces shall be blast cleaned to near white metal surface (Sa 2 1/2) and zinc silicate primer (minimum DFT 75 microns) shall be applied. For blast cleaning of steel surfaces and application of the primer, reference may be made to the specification for the fabrication and erection of structural steel elsewhere in the document. Zinc silicate primer shall be followed by intermediate coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide pigmented and finish coat of minimum 75 microns (DFT) of epoxy based coloured pigmented finish polyamide cured paint and final finish coat with minimum 25 micron DFT polyurethane colour pigmented paint			
3.03.02		The door frames shall be fixed to the wall with the help of hold fasts, embedded in the concrete block. However, for RCC surfaces, expansion fasteners shall be used. The gap between masonry and doorframe shall be caulked with mastic.			
3.03.03		Fitting and fixing in position shall be similar to aluminum work of doors, windows etc. After installation of steel door, etc., all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat. All coupling mullions, transoms, frames, etc., in contact with adjacent steel and other members, shall be well bedded in mastic.			
3.04.00		Solid core flush door shutter			
3.04.01		Solid core flush shutters with 35mm thick decorative type core of block board construction shall conform to IS: 2202 (Part-I) and shall be as described in Schedule of Quantities.			
3.04.02		Door shall be fitted with hardware like butt hinges, wood screws, handles, sliding and tower bolts, door stoppers and door closers, lock (6 lever Godrej or equivalent) etc. All fittings shall be of anodised aluminium & electro colour dyed.			
3.05.00		DELETED			
3.06.00		Hollow metal double sheet steel doors			
3.06.01		Frames for hollow metal double plate flush doors shall be fabricated from 1.6 mm thick sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced			
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	for door closers. Welded construction with mitred corners shall be used. Rubber door silencers shall be furnished for striking jamb. Loose “T” masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place.				
3.06.02	Door shutters shall be double plate flush door construction. This shall be 45 mm thick completely flush design and shall comprise of two outer sheets of minimum 1.2 mm thick steel sheets, rigidly connected and reinforced inside with continuous vertical 1 mm stiffeners, spot welded in position at not more than 150 mm on centers. Horizontal stiffeners shall also be provided. Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally by steel channels placed immediately inside and welded to the door faces. Doors shall not have more than 2.5 mm clearance at jambs and head, shall have proper bevel on lock stiles and rails to operate without bending, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting stile edges beveled or rebated. Where shown on drawing or called for in the schedule of items, the doors shall be sound deadened by filling with insulating material. Doors shall be morticed, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push plates and other surface hardware where necessary. Any drilling and tapping required for surface hardware shall be done at site.				
3.06.03	Steel surfaces shall be blast cleaned to near white metal surface (Sa 2 1/2) and zinc silicate primer (minimum DFT 75 microns) shall be applied. For blast cleaning of steel surfaces and application of the primer, reference may be made to the specification for the fabrication and erection of structural steel else where in the document. Zinc silicate primer shall be followed by intermediate coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide pigmented and finish coat of minimum 75 microns (DFT) of epoxy based coloured pigmented finish polyamide cured paint and final finish coat with minimum 25 micron DFT polyurethane colour pigmented paint.				
3.06.04	Fitting and fixing in position shall be similar to aluminum work of doors, windows etc. After installation of steel door, etc., all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat. All coupling mullions, transoms, frames, etc., in contact with adjacent steel AND OTHER MEMBERS, SHALL BE WELL BEDDED IN MASTIC.				
3.07.00	Fire Proof Door				
3.07.01	Fire proof doors shall be provided at all fire exit points and also to restrict the spread of fire within buildings whether from internal fire or from external fire. Doors shall comply with the testing requirement mentioned in IS:3614 (Part-II) & BS 476 Part 22. The doors shall have minimum 2 hours fire rating.				
3.07.02	Doorframe shall be of minimum 1.6mm thick galvanized steel sheet pressed form to double rebate profile so as to accommodate minimum 45 mm thick shutter.				
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	The shutter panel shall be fabricated with 2 numbers, minimum 1.25mm thick galvanized steel sheet pressed formed having lock seam joints and reinforcements at top, sides and bottom of edges. The shutter shall have infill of insulation for fire rating. Integrated Vision panel shall be provided in shutter as per drawing. The doorframe and door shutter shall be blast cleaned to near white metal surface. Frame and shutter shall be primed and finished with suitable fire retardant paint of approved shade & colour. Prototype of Door shall be got tested at CBRI, Roorkee & certificate to this effect shall be submitted along with Manufacturer's test certificate. The work shall be complete as per specification and instruction of Engineer-in charge.			
3.07.03	Fitting and fixing in position shall be similar to aluminum work of doors, windows etc. After installation of steel door, etc., all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat. All coupling mullions, transoms, frames, etc., in contact with adjacent steel and other members, shall be well bedded.			
3.08.00	ANODIZED ALUMINIUM WORKS FOR DOORS, WINDOWS, VENTILATORS, PARTITIONS ETC.			
3.08.01	Extruded standard and other sections shall generally be used. Section shall have a minimum wall thickness of 2mm or section as indicated in the working drawings and as per Sections of Hindalco/ Indalco/ Jindal/ Bhorka. All sections shall be approved by the Engineer before work is taken up. For general guidance for aluminum works. IS:1948 and IS:1949 shall be followed. Neoprene felt required for bimetallic protection shall be provided. Portions of Aluminium frame which come in contact with masonry construction, shall, before shipment from workshop, be protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be provided with protective coating to prevent bi-metallic corrosion.			
3.08.02	Fitting and fixing - Fixing shall be done with rawl plugs, expansion fasteners, Screws, fixing clips, necessary filling up of gaps at top, bottom and sides. In general, the fixing of all metal doors, windows, ventilators, louvers etc. shall conform to IS:1081, and/or as shown on drawings. This fixing of doors, windows, ventilators, louvers etc. can be to metal cladding, brick masonry, steel/ RCC member, etc. as shown in drawings. Fixing screws, hold fasts, rawl plugs, expansion fasteners, fixing clips etc. required for fixing shall be provided. The Contractor shall assemble and install all doors, windows, ventilators, partition frames sashes, fixed metal louvers etc. including transoms and mullions for composite units in respective places as shown on drawings, keeping proper lines and levels, and in approved workman like manner, to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation. Door shutters, partitions, hardware, fitting, fixtures, etc., shall be fixed only after major equipment have been installed in rooms. Wherever required neoprene gasket shall be used for sealing the joint. It shall be the responsibility of the			
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		Contractor to see that the material is protected from mortar, paint, plaster, weld spatter etc. till handing over to the Owner.		
3.09.00	Windows Grills	Anodised aluminium grills shall be of approved design patterns. These shall be fixed on to the aluminium framework of windows / Ventilators by using anodised aluminium screws. Necessary openings shall be provided in the grill to facilitate the operation of the windows/ ventilators.		
3.10.00	Rolling Steel Shutters/Grills			
3.10.01	Rolling Shutters / grills shall be with motor drives, gear arrangement and / or manual operation as specified in schedule of items including all accessories and shall conform to IS:6248. All Electrical work shall be in strict accordance with the relevant Indian Electricity Rules.			
3.10.02	Shutters shall be painted with one coat of zinc silicate primer (minimum DFT 75 microns) after blast cleaning the surface to near white metal surface (Sa 2 ½). Zinc silicate primer shall be followed by intermediate coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide pigmented and finish coat of minimum 75 microns (DFT) of epoxy based coloured pigmented finish polyamide cured paint and final finish coat with minimum 25 micron DFT polyurethane colour pigmented paint			
3.10.03	After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The shutters shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.			
3.11.00	Sliding Door			
3.11.01	This shall be provided as described in the schedule of items.			
3.12.00	DELETED			
3.13.00	Steel Windows with Steel Louvers			
3.13.01	Standard rolled steel sections shall be used & shall include frame & shutters, transoms, mullions, fittings & fixtures, grouting of frames, painting with shop coat of primer & three coats of synthetic enamel paint of approved brand & required colour shade, mastic, caulking handles, hold fasts, hinges etc. All section shall be aproved by the Engineer, before work is taken up. For general guidance for steel works IS: 1038 / IS:1361 shall be followed.			
3.13.02	Fabrication and Fixing: Frames and shutters shall be constructed of sections which have been cut to length and mitred. The steel sections shall conform to IS: 7452. Mild steel louvers shall be of minimum 1.2mm thickness, shaped to profile and with channel frame and sag rods as per approved design. 30mm x 30mm mesh size welded wire fabric (1.6mm IRC) shall be provided from inside with cutout for operating the handle. The shutters shall be provided with MS powder coated handles and peg stays. Frame shall be fixed to			
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		the surrounding steel frame with hinges.		
3.13.00		The Contractor shall take every precaution against damage of the components during installation. All frames and shutters shall be thoroughly cleaned and painted with primer coat and intermediate coat, finish coat and final finish coat of paint as per relevant specification.		
4.00.00		GLASS AND GLAZING		
4.01.00		General Requirement		
4.01.01		This part of the specification covers the requirement of providing fitting and fixing in position of glazing of different thickness comprising of clear float glass, wired glass, tinted glass, toughened glass, laminated glass and hermetically sealed composite double glazing complete with all clips, putty, mastic, etc., including glass block masonry. IS:1081 and IS:3548 shall be followed as guidance for glazing work.		
4.01.02		Materials		
		a) All glass and glazing shall have uniform refractive index and free from flaws, specks, and bubbles.		
		b) The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. The cut edges shall be straight and free from hips, spells or any other damages.		
		c) Clear glass shall be float glass & toughened glass and shall be of thickness as specified in Schedule of items. Properties of float glass shall generally meet the requirements of IS:14900.		
		d) Composite double glazing shall be made of double glazing of two 6 mm thick with one side clear float glass and other side tinted glass. Both the glasses shall be separated by an air gap of 12 mm. The trapped air shall be kept dry by means of suitable desiccant. The glass shall be hermetically sealed. The sealing shall be under strict quality control. The composite glazing shall be procured as finished product.		
		e) The putty shall conform to IS:419 and shall be of best quality and shall be brought to site in manufacturer's original packing. Quick setting putty shall be used for windows and sashes except when glare reducing glass is used where it shall be of non- setting type.		
		f) Material for glass block masonry work shall be as per the best industry practice.		
		g) Composite double glazing, 24mm thick shall consist of 6mm thick clear float glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air gap and hermetically sealed by beading of anodized Aluminium with outer edge sealed with silicon sealant. Composite double glazing shall have technical characteristics as mentioned below.		
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Clause No.		FINISHING AND ALLIED WORKS	
		Solar factor : 25% or less U -value : less than 1.6 W/m².K VLT : Minimum 40% The glass to be used should be from Saint Gobain (India) or Ashai (India) or equivalent. The glass should be free from distortion and thermal stress. The composite double glazing shall be designed for a wind pressure 150Kg/Sq.m taking into consideration the prevalent site conditions and window openings profile. Vendor shall submit drawing of individual members clearly indicating all dimensions, wall thickness and weight (kg/m). No extra claims shall be entertained at any stage for aluminium profile, wall thickness & size dimensions. The vendor shall be required to submit complete shop drawings showing the details of the following:- Calculation of wind pressure applicable to the building. All fixing arrangements Typical profile combination details The vendor shall get approval of shop drawing from the Engineer-in-charge, before commencing the execution of work.	
2.02.00		Fitting and Fixing	
2.02.01		All glazing clips, putty, mastic, etc. as required shall be provided.	
2.02.02		All glasses shall be thoroughly cleaned before setting in position. Wherever required, glass pane shall be held in place by special glazing clips of approved type. Four glazing clips shall be provided per glass pane except for large panes where six or more clips shall be used. All holes that may be necessary on the anodised aluminium doors, windows etc for holding the clips, glazing beads and all other attachments shall be drilled in position. Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where moulding or gaskets are provided. Putty, mastic etc. shall be smoothly finished to a true even line.	
2.02.03		After completing the glazing work, the Contractor shall remove all dirt, stains, excess putty and clean the glass panes and leave the work in perfectly acceptable condition. All broken, cracked or damaged glass shall be replaced by new ones.	
2.02.04		Double glazing shall be thematically sealed.	
		The glass must be protected during installation period so that they will not be damaged by splashed of cement, welding, grinding etc.	
		The stains caused by welding and grinding will permanently damage the glass and shall require replacement immediately.	
		Labels, tapes, adhesives, writing with chalk or any other tool shall never be done on the coating of glazing.	
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Clause No.		FINISHING AND ALLIED WORKS	
		After the completion of installation, the glazing shall be immediately washed with clean water. When assembling and installing the glazing, the position of coating is of crucial importance and the same be positioned as indicated in the drawings.	
2.02.05		Glazing shall be carefully done to avoid direct contact with metal frames.	
2.02.06		Glass block masonry shall be laid by using the adhesive as per the best industry practice.	
2.02.07		No separate measurement shall be made for. - Glazing clips, mastic cement, putty, screws, nails etc. nor for drilling holes, in frames for inserting glazing clips. However, aluminum beading shall be paid along with anodised aluminum works. - Cutting of glass to required size, wastage, edge finishing, etc. - Cleaning the glass after installation.	
4.03.00		Poly Carbonate Sheet	
4.03.01		Poly Carbonate sheet shall be clear sheet of minimum 2mm thickness as specified with corrugated profile matching with that of metal sheeting. It shall be free from flaws, specks and bubbles. It shall have 40% light transmission value with class-I fire rating.	
4.03.02		Poly carbonate sheet shall be bought to site with masking film and cut to size at site. The sheets shall be fixed to steel runners along with metal sheeting. Masking film should be removed immediately after the installation. Adequate thermal expansion allowance shall be ensured and UV coated side shall be facing sun light. Finally the sheets shall be cleaned with warm mild soap solution using soft sponge.	
5.00.00		False ceiling	
5.01.00		GENERAL REQUIREMENT	
5.01.01		This part of the specification covers the requirement of the false ceiling system of Glass Fiber Reinforced Gypsum Plaster Board (having gypsum core mixed with glass fiber) False Ceiling System having fine texture finish and pre-painted coil coated steel ceiling system all complete with supporting grid system galvanized wires, height adjustment clips, providing openings for A.C. ducts, return air duct, light fixtures, grills etc	
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Clause No.		FINISHING AND ALLIED WORKS			
5.01.02 Materials					
a) Glass Fiber Reinforced Gypsum Plaster Board shall meet the requirement of IS: 2095 (Part-3). Nominal thickness of the board shall be 12.5 mm. Fine textured finish shall be provided. Nominal size of the board shall be 600x600 mm. Bigger size panels shall be used for flat construction.					
b) Mineral Fibre Board Acoustical Tiles 15mm thick shall be of rebated edge suitable for grids of nominal sizes 600mm x 600mm and as per approved manufacturer's specifications.					
c) Tile type pre-coated steel false ceiling panel shall be of square type. Size of the tile shall be 600 x 600 mm and thickness of the sheet (bare metal) shall be minimum 0.5 mm. Coating shall be applied by coil coating process. Rate of galvanisation shall be 180 gm / Sq.M. (grade 180 as per IS : 277) and thickness of regular modified polyester/super polyester paint over primer shall be 20 microns. The thickness of primer coat shall be 5 micron.					
d) Lineal Panel type Pre coated steel False ceiling system shall be of same material as specified for tile type. Nominal width of the panel shall be 100 mm.					
e) Supporting grid system shall be of galvanized light gauge steel minimum (bare metal thickness) 0.8 mm thick and galvanized at the rate of 180 grams per Sq.M.					
f) Metal ceiling in SS brush type finish instead of pre-painted coil coated finish as required.					
g) Plaster of Paris:- The Gypsum plaster (gypsum Anhydrous) conforming to IS: 2547 shall be used for plaster of Paris work. The plaster of Paris shall be mixed with water to a workable consistency and shall be applied on GRG plaster board false ceiling and finished to a smooth surface. The finished surface shall be smooth and true to plane, slopes or curves and providing cornices & beading in false ceiling. The nominal thickness shall be 2 mm.					
h) G.I. metal Clip False ceiling system shall be as mentioned in schedule of items.					
5.02.00 Fixing and Fitting of False Ceiling					
5.02.01 Glass Fibre Reinforced Gypsum Plaster Board					
Load bearing galvanized light gauge sections shall be used for supporting of (seamless) finished ceiling. G.I. Channels of size 0.55 mm thickness having one flange of 20 mm and another flange of 30 mm, and a web of 27mm shall be fixed along with perimeter of ceiling, screw fixed to brick wall / partition with the help of nylon sleeves & screws at 610 mm centres. Then suspending G.I. intermediate channels of size 45 mm, 0.9mm thick with two flanges of size					
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Clause No.		FINISHING AND ALLIED WORKS		
	15 mm each from the soffit at 1200mm centres with ceiling angle of width 25 mm x 25 mm x 0.55 mm thick fixed to soffit with G.I. cleat and steel expansion fastener. Ceiling section of 0.55 mm thickness having knurled web of 51.5 mm and two flanges of 26 mm each with lips of 10.5 mm are then fixed to the intermediate channel with the help of connecting clips and in direction perpendicular to the intermediate channel at 457 mm centres. 12.5mm thick Glass Fiber Reinforced Gypsum Plaster Board is then screw fixed to ceiling sections with 25 mm dry wall screws at 230 mm centres. The board shall be jointed and finished to have a flush look.			
5.03.00	For laying Mineral Fibre Board in tile of 600 mm x 600 mm the supporting grid system shall be formed by light gauged galvanized steel T- sections. Supporting grid system shall be of rolled formed double web galvanized tees and shall meet the requirements of ASTM C-635. Nominal size of T-section shall be 24x38 mm for main runner. Exposed flange surface i.e. 24 mm wide shall be pre-coated or provided with a matching coloured cap. Main supporting section shall be suspended from R.C.C soffit/steel member with 4 mm diameter galvanised rod & spring steel level clip @ 1200 mm c/c. Suspensions from R.C.C shall be taken using expansion fasteners. The main supporting member shall be placed @1200 mm Cross T-section is inserted into the slots provided in main supporting member at 600 mm c/c. So as to give a maximum grid size of 1200 mm x 600 mm. Mineral Fibre Board Tiles shall be laid onto the grid. 4 nos. of PVC holding clips shall be provided for each panel.			
5.04.00	Pre Painted coil coated steel false ceiling system. (A) Tile type false ceiling shall be supported on T-frame as specified for laying in tile of 600 mm x 600 mm above Lineal type false shall be supported/ clipped into the galvanized carriers suspending from the soffit/structural members. (B) Wherever required under deck insulation shall be laid above the steel ceiling system as specified elsewhere in this specification.			
5.05.00	Calcium Silicate False Ceiling False ceiling of 12 mm thick calcium silicate board with suspension system as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete (with concealed grid and finished flat seamless).			
6.00.00	Water proofing treatment			
6.01.00	General Requirement			
6.01.01	This part of the specification covers the requirement of providing water proofing treatment of roof or any other RCC surface under water pressure using high solids content Polyurethane based cold liquid applied coating.			
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Clause No.		FINISHING AND ALLIED WORKS	
6.02.00	Materials		
6.02.01	High solids content Polyurethane based cold liquid applied coatings shall be as per ASTM C836-89 and shall comprise of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic. Any other equivalent material formulation permitted as per ASTM can also be considered for use. The material shall consist of high solids coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical features like high viscosity, min. 80% solids, high resistance to impact, abrasion and cracking, superior tensile strength, 300% elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates. It should also be resistant to acid (mild concentrated), alkalis and have a very low water absorption rate (0.5% max.) at ambient temperature after 7 days. The material shall not be older than 9 months after the date of manufacture and packing.		
6.02.02	Reinforcing layer for the membrane shall be non-woven polyester scrim cloth. This shall be made of 100% polyester. Weight of cloth shall be 40 g/Sq.M. (min).		
6.02.03	Extruded high density dimpled polyurethane shall have minimum weight of 500 gms/ Sq.M., minimum thickness 0.5 mm and mechanical resistance to compression not less than 230 KN / Sq.M. The stud height shall be 8 mm and minimum numbers of stud shall be 1800 / Sq.M.		
6.02.04	Materials for cement mortar under bedding, cement-sand plaster over concrete roof and cement concrete under bedding shall be as specified elsewhere in this specifications.		
6.02.05	Fixing and Laying		
	ASTM C898 – 89 shall be followed as general guidance.		
6.03.00	Water Proofing Treatment for Roof		
6.03.01	Different layers required for water proofing treatment for roof shall be as shown on the working drawings. Different layers shall consist of the following		
	a) Grading under bed. b) Elastomeric membrane. c) Wearing course		
6.03.02	Grading Underbed		
	The underbed shall be laid to provide an ultimate run - off gradient not less than 1 in 100 or as specified in the drawing. However no underbed is required where the slope has been provided in the structural frame work/ concrete. Upto an average thickness of 25 mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The surface of roof and that part of the parapet, gutters, drain channels, drain mouths, or any other RCC surfaces etc., over which the underbed is to be applied shall be roughened and thoroughly cleaned of all foreign matter namely fungus, moss and dust, with wire brushing and dusting. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.		
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The plaster shall be provided as specified elsewhere in this specification and this shall be laid to proper grade in continuous operation and fully compacted. The concrete shall be used where the underbed is more than 25 mm (average) thick. It shall consist of cement concrete of grade M-20 with 12.5 mm nominal size graded aggregate. The mix shall be laid to proper grade in continuous operation and fully consolidated. The surface shall be even and smooth. Concrete work wherever required shall be done as specified elsewhere in this specification.			
6.03.03			
Elastomeric membrane			
a) For preparatory work, IS: 3067 shall be followed as a general guidance for laying the roof waterproofing treatment . The roof surface shall be thoroughly cleaned with a wire brush and all foreign matter, etc. shall be removed. Well defined cracks on the surface shall be cut to 'V' section, cleaned and filled up flush with a paste of polyurethane based crack filling compound and white cement in a ratio of 1:2 or polymerised mastic (Bitumen mixed with inert fillers or Elastomeric membrane). Water proofing treatment shall be carried out into the drain pipe or out-lets by at least 100 mm. For rain water pipe out-lets, a groove shall be cut all round to tuck the treatment. When a pipe passes through a roof on which water proofing treatment is to be laid, a cement concrete angle-fillet shall be built round it and the water proofing treatment taken over the fillet. In case of parapet walls, for tucking in the water proofing treatment, a horizontal groove shall be left in the vertical face at the time of construction. At the junction between the roof and the vertical face of the parapet wall, a cement concrete fillet 75 mm (min) in radius shall be constructed. At the drain mouths, the fillet shall be suitably cut back and rounded off for easy application of the water proofing treatment and easy flow of water.			
b) Application			
i) Primer Coat			
It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of not more than 6 Sq.M. per liter. The primer shall be allowed to dry for a minimum of 2 hours but not more than 24 hours time before the successive finishing coats of P.U. liquid membrane are applied.			
ii) Finishing Coats			
The finishing coats shall consist of minimum two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. Application shall be with brush or spray to form an uniform jointless elastomeric membrane. The overall dry film thickness excluding primer coat shall be 1.5 mm. However, nominal rate of total liquid coating application shall not be less than 1.6 kg. /Sq.M. excluding primer coat. Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface shall be dry and smooth before application. The coating shall be continued upto parapets / walls for a minimum of 150 mm over the finished roof surface. It shall be continued into rain water pipes by at least 100 mm into inner			
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		surface of pipe. Reinforcing layer of polyester scrim cloth shall be placed over the 1st coat when the coat is tacky. The surface shall be dry and smooth before application. The coating shall be continued up the parapets/walls for a minimum of 150 mm over the finished roof surface. Fine silica sand shall be spread over the final coat when coat is tacky to obtain a rough surface. Water proofing of membrane shall be tested by pounding of water.	
6.03.04	Wearing Course	a) Finishing coat of elastomeric membrane shall generally be provided with wearing course consisting of minimum 25 mm thick PCC of Grade M20 (using 12.5 mm size aggregate) cast in panel of maximum size of 1.5 m x 1.5m and reinforced with galvanised chicken wire mesh. Sealing of Joints at the panel junctions shall be done using non bitumastic sealant/ elastomeric compound. Wearing course shall not be provided for vertical surfaces and inaccessible areas provided with elastomeric membrane. PCC wearing course and chicken wire mesh shall be provided as mentioned elsewhere in this specification. b) The area of the roof surface which is subjected to foot traffic or used as a working area, shall be suitably protected, as mentioned elsewhere in the specification, in such a way so to keep the top of the protective coating matching with top surface of the wearing course.	
6.04.00	Water Proofing Treatment for basement type structure		
6.04.01	The elastomeric membrane for the raft shall be provided over the lean concrete / PCC. The membrane shall be applied in the similar manner as mentioned for water proofing treatment for roof. The top surface of elastomeric membrane shall be protected by providing 20 mm thick PCC of grade M20 (using 12.5 mm size aggregate) cast in panel of maximum size 1.5 m x 1.5m.		
6.04.02	The elastomeric membrane for the vertical wall shall be provided on the outer face exposed to water pressure. The membrane shall be applied in the similar manner as mentioned for water proofing treatment for roof. The exposed surface of elastomeric membrane shall be protected by providing extruded high density dimpled polyurethane membrane.		
7.00.00	FENCING AND GATES		
7.01.00	General Requirement		
7.01.01	This part of the specification covers the requirement of providing PVC coated chain link fencing, welded wire mesh, reinforced barbed tape and MS Gates.		
7.01.02	Materials		
	a) PVC coated chain link fencing shall be of mesh size 75 mm and of minimum 4 mm diameter (including PVC coating) and diameter of bare galvanized wire shall not be less than 2.5 mm as per IS 272.		
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		b) Welded wire mesh shall conform to IS:1566. Mesh size shall be as indicated in the drawing. c) Reinforced barbed tape shall consist of flattened and cold drawn, galvanised to 230 g./Sq.M. (as per IS:2629), unalloyed wire as per Grade-II of IS:4454 Part-I having a nominal bare metal diameter of 2.60mm and minimum tensile strength of 1600 N / Sq.mm. and a low carbon steel strip 19 mm wide and 0.5 mm thick and conforming to IS: 513 with hardness between 137 to 180 VPN, having series of sharp barbs punched all along the length on both sides of strip at regular intervals (24 mm approx.) and electro galvanised with 12 to 18 microns of zinc coating as per requirement of IS:1573. d) MS gates shall be made of structural steel conforming to IS 2062, pipe conforming to IS 1161, steel sheet conforming to IS 513 and IS 1079. All guide track, tempered steel pivot, castor, bronze aluminium ball and bearing etc. shall also be of best and heavy quality and shall provide smooth operation.	
7.02.00		Fencing	
7.02.01		Supporting vertical steel post and toe wall wherever required for fencing shall be provided as part of structural steel and masonry work, as specified elsewhere in this specification. The chain link will be stretched and attached by 'C' clips at 0.5 m intervals to 3 strands of high tensile spring steel wire (HTSSW) of 2.5 mm interwoven in chain link wire mesh and kept under tension which in turn are attached to the fence post with security nuts and bolts. On every fourth post, a clamping strip will be threaded through the links of chain link and bolted to the fence post with the help of security nuts and bolts.	
7.02.02		The mild steel frame work for fixing of the welded wire mesh shall be provided as part of structural steel and masonry work, as specified elsewhere in this specification. The welded wire mesh shall be fixed to the steel frame work by using mild steel beading, screwing and welding. Welded wire mesh shall be finished by blast cleaning of steel surfaces to near white metal surface (Sa 2 ½ Swedish standard), applying inorganic zinc silicate primer of minimum 75 microns (DFT), application of intermediate (under) coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide, followed by finish painting with Epoxy based colour pigmented finish Poly Amide cured paint.	
7.02.03		The reinforced barbed tape shall be stretched and fixed in specified number of rows and two verticals strands. The bottom row shall be 10.0 cm above ground and the rest at 15.0 cm center to center. The reinforced barbed tape shall be held to the RCC / steel posts by means of G.I. hair pins and washers. Turn buckles and straining bolts shall be used for fixing of the barbed tape.	
7.03.00		Gates	
7.03.01		Finished material shall be free from imperfect edges and other defects. It shall have a smooth, uniform finish, and shall be straightened. It shall also be free from loose mill scale, rust, pits or other defects affecting its strength and durability.	
7.03.02		The fabrication and erection of gate shall be carried out as per the working drawing developed by Contractor and approved by Engineer. All fabrication and erection work shall be done as per IS: 800.	
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7.03.03	All Structural Steel works shall be painted with shop coat of approved zinc silicate primer (minimum DFT 75 micron) over blast cleaned surface to near white metal surface (Sa 2-1/2) and final painting shall be with epoxy-based finish poly amide cured painting system consisting of three coats as specified for structural steel works. Blast cleaning of steel surfaces shall be done as specified in the technical specification for the fabrication and erection of structural steel work.			
7.03.04	The gate shall be complete with guide track, castor wheel, ball and bearing, all fitting and fixtures like hinges, aldrops, locking arrangement, stubs, posts, tempered steel pivots, tempered steel templates, etc.			
8.00.00	SAMPLING, TESTING, ACCEPTANCE CRITERIA INCLUDING CONSTRUCTION TOLERANCES			
8.01.00	Frequency of sampling, testing and quality assurance including the method of conducting the tests, acceptance criteria and construction tolerances shall be as given in Part-C of this specification.			
9.00.00	RATES AND MEASUREMENTS			
9.01.00	Rates			
	This clause shall be read in conjunction with the clause for the rates given in Part-A of this specification			
9.01.01	Unit rates for providing and laying floor-finishing materials shall also include for provision of side shuttering (if required) for casting of floor in alternate panels			
9.01.02	Unit rate for anodized aluminum works shall be applicable for all type aluminium work except aluminium grills and shall also include for provisions for all hardware, fitting and fixtures for fixed as well as operable type of unit.			
9.01.03	Unit rate for rolling / sliding shutter shall also include for			
	i) Provision of locks, guide channels, and drive as specified.			
	ii) In case of electrically operated rolling shutter, the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.			
9.01.04	Unit rate for aluminium grills shall also include the fixing the grills in aluminium windows, ventilators, etc at all elevations.			
9.01.05	Unit rate for glazing including composite double glazing shall also include for provisions of glazing clips, mastic cement, putty, screws, nails etc., for drilling holes, in frames for inserting glazing clips. cutting of glass to required size, edge finishing, for cleaning the glass after fitting and fixing.			
9.01.06	The unit rate for providing, fabrication, transportation and erection of structural steel work in gate shall also include the provision of all materials, wastage, labour, tools and plant required for fabrication, including welding, supply & fitting of all accessories, erection, surface preparation by blast cleaning and epoxy painting.			
9.01.07	The unit rate for providing and laying rubber flooring shall include the provision of all			
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		materials including suitable adhesive required for executing the work.	
9.02.00	Measurements		
		This clause shall be read in conjunction with the clause for the measurement given in Part-A of this specification.	
9.02.01		The item of providing and laying floor-finishing materials shall be measured in Sq.M. for net area except interlocking concrete blocks. Any opening less than 0.1 Sq.M. shall neither be taken into account nor shall any extra be paid for it. Measurement for interlocking concrete blocks of various sizes and thickness shall be made in Cu.M. based on the theoretical volume or the net volume of the concrete block, whichever is less. Ready mix non-metallic granules shall be measured by weight in MT of the net granules spread.	
9.02.02		The item of providing, fitting and fixing of steel door frames, shall be measured in running meter along the center line of frames provided.	
9.02.03		The item of providing, fitting and fixing of solid core flush door shutters, shall be measured in Sq.M. for the net area of shutters provided. Any opening upto 0.1 Sq.M. shall be neglected as non existent for the purpose of measurement however if the opening area is more than 0.1 Sq.M. then same shall be considered for deduction in calculating the net area.	
9.02.04		The item of providing, fitting and fixing of BWP particle board decorative veneered, shall be measured in Sq.M. for the net area provided. Any opening upto 0.1 Sq.M. shall be neglected as non existent for the purpose of measurement however if the opening area is more than 0.1 Sq.M. then same shall be considered for deduction in calculating the net area.	
9.02.05		The item of providing, fitting and fixing of hollow metal double sheet steel door shall be measured in Sq.M. for the net outer-to-outer area of door provided.	
9.02.06		The item of providing, fitting and fixing of fire proof doors shall be measured in Sq.M. for the net outer-to-outer area of door provided.	
9.02.07		The item of providing, fitting and fixing of anodised aluminum works for doors, windows, ventilators etc including aluminium beadings, aluminium fittings and fixtures etc. shall be measured by weight in kg based on the calculations made for the fabricated sections using standard unit weight of the sections and/or actual weight whichever is less.	
9.02.08		The item of providing, fitting and fixing of anodised aluminium grills shall be measured by weight in kg based on the actual weight of the grill.	
9.02.09		The item of providing, fitting and fixing of rolling shutters and sliding doors shall be measured as the area of openings in Sq.M. over which rolling shutters / sliding doors have been provided.	
9.02.10		The item of automatic operation system for doors shall be measured in Sq.M. for every door opening for which the said system is provided.	
9.02.11		Steel louvers wherever provided shall be measured under the item of fabrication and erection of structural steel as specified in structural steel section module.	
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9.02.12	The item of providing, fitting and fixing of glazing (float glass, wired glass, tinted glass) shall be measured as the actual area of the glass provided in Sq.M. (including the portion of glass covered behind support).			
9.02.13	The item of providing, fitting and fixing of composite double glazing shall be measured as actual area provided in Sq.M. as composite unit (separate measurement shall not be made for each of the two layers).			
9.02.14	The item of glass block masonry shall be measured as actual area provided in Sq.M.			
9.02.15	The item of providing and fixing GRG false ceiling system, Mineral Fibre Board false ceiling system and pre coated steel false ceiling system shall be measured as actual surface area laid in square meters. However, no deduction shall be made for opening up to 0.25 Sq.M. each in area.			
9.02.16	The item of providing, laying and fixing in position of water proofing shall be measured as net surface area in Sq.M. Grading under bed, grading course, fillet, plaster, etc., when provided, shall be measured under relevant item of work.			
9.02.17	The item of providing and laying extruded high density dimpled polyethylene membrane shall be measured as net surface area in Sq.M.			
9.02.18	The item of providing and installing PVC coated chain link fencing shall be measured for the net surface area provided in Sq.M. Steel post / toe wall / concrete shall be measured separately under relevant item of work.			
9.02.19	The item of providing and installation of welded wire mesh shall be measured by weight in M.T. based on the theoretical weight and or actual weight whichever is less.			
9.02.20	The item of providing and installation of reinforced barbed tape shall be measured by weight in M.T. based on the theoretical weight and or actual weight whichever is less.			
9.02.21	The item of providing, fabrication, transportation and erection of structural steel work in gates shall be measured in kg. of the net weight of metal including accessories in the fabricated structure.			
9.02.22	The item of providing & fixing Curved Dome on Roof shall be measured in 'unit nos.' provided.			
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION			
SECTION-6					
WATER SUPPLY, DRAINAGE AND SANITATION					
1.00.00	GENERAL REQUIREMENTS				
1.01.00	Content				
	This section covers the technical requirements for medium grade galvanised mild steel water pipes, stop cocks, toilet block, pantry block, cast iron soil pipes, non - pressure RCC pipes, RCC manholes and connection of drains / sewer lines and similar works.				
1.02.00	Codes and Standards				
1.02.01	Some of the relevant applicable Indian Codes, Standards and Acts are referred to herein below : (latest Edition)				
	IS : 458	:	Specification for Concrete Pipes.		
	IS : 554	:	Dimensions for Pipe Threads, where Pressure Tight Joints are made on Thread.		
	IS : 771	:	Glazed Fire Clay Sanitary Appliances. (Part I to VII)		
	IS : 774	:	Flushing Cisterns for Water Closets and Urinals.		
	IS : 775	:	Cast Iron Brackets and Supports for Wash Basins and Sinks.		
	IS : 778	:	Copper Alloy Gate, Globe and Check Valves for Water Works Purposes		
	IS : 781	:	Cast Copper Alloy Screw Down Bib Taps and Stop Valves for Water Services		
	IS : 782	:	Caulking Lead.		
	IS : 783	:	Code of Practice for Laying of Concrete Pipes.		
	IS : 1172	:	Basic Requirements for Water Supply, Drainage and Sanitation.		
	IS : 1239	:	Mild Steel Tubes, Tubular and Other Wrought Steel Fittings.		
	IS : 1536	:	Centrifugal Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage.		
	IS : 1538	:	Cast Iron Fittings for Pressure Pipe for Water, Gas and Sewage.		
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION		
		IS : 1703	: Ball Valves (Horizontal Plunger Type) including Float for Water Supply Purposes.	
		IS : 1726	: Cast Iron Manhole Covers and Frames.	
		IS : 1729	: Sand Cast Iron Spigot and Socket, Soil, Water and Ventilating Pipes, Fittings and Accessories.	
		IS : 1742	: Code of Practice for Building Drainage.	
		IS : 2064	: Code of Practice for Selection Installation and Maintenance of Sanitary Appliances.	
		IS : 2065	: Code of Practice for Water Supply in Building.	
		IS : 2501	: Copper Tubes for General Engineering Purposes.	
		IS : 2548	: Plastic Seat and Cover for Water - Closets.	
		IS : 2556	: Vitreous Sanitary Appliances - (Vitreous China).	
		(Parts 1 to 15)		
		IS : 2633	: Method for Testing uniformity of Coating on Zinc Coated Articles.	
		IS : 2629	: Recommended Practice for Hot Dip Galvanizing on Iron and Steel.	
		IS : 2963	: Non Ferrous Waste Fittings for Wash Basins and Sinks.	
		IS : 3114	: Code of Practice for Laying of Cast Iron Pipes.	
		IS : 3311	: Waste Plug and its Accessories for Sinks and Wash Basins.	
		IS : 3438	: Silvered Glass Mirrors for General Purposes.	
		IS : 4111	: Code of Practice for Ancillary Structure in Sewerage system.	
		(Part I to IV)		
		IS : 4827	: Electro Plated Coating of Nickel and Chromium on Copper and Copper Alloys.	
		IS : 5219	: Cast Copper Alloys Traps.	
		IS : 5329	: Code of Practice for Sanitary Pipe Work above Ground for Buildings.	
		IS : 5382	: Rubber Sealing Rings for Gas Mains, Water Mains and Sewers.	
		IS : 5822	: Code of Practice for Laying of Welded Steel Pipes for Water Supply	
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION		
	IS : 8931	:	Cast Copper Alloy Fancy Bib Taps and Stop Valves for Water Services	
	IS : 8934	:	Cast Copper Alloy Fancy Pillar Taps for Water Services	
	IS : 10446	:	Glossary of Terms for Water Supply and Sanitation.	
	IS : 12701	:	Rotational Moulded Polyethylene Water Storage Tanks.	
	IS : 13983	:	Stainless Steel Sinks.	
	SP : 35	:	Hand Book on Water Supply and Drainage.	
2.00.00		TOILET BLOCK AND PANTRY BLOCK		
2.01.00		General Requirement		
This part of the specification covers the requirement for provision of the toilet block and pantry block in totality and completeness with respect to sanitary and toiletries items, including all fittings and fixtures whatsoever required, for the commissioning and efficient working. This shall include but not limited to the supply and installation of water supply / sanitary fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc., water supply / sanitation pipes, water storage tank (overhead / loft type) in various toilet / pantry blocks. All fittings and fixtures shall generally conform to relevant Indian standards.				
2.02.00		Material		
2.02.01		All pipes, fittings, fixtures, appliances and accessories shall conform to the relevant Indian Standards and shall be of 1st class quality.		
2.02.02		All material, fittings, fixtures, appliances, accessories shall be from reputed brands (manufacturer) as approved by the Engineer. The contractor shall submit samples of materials, as directed by the Engineer, which may be retained by him for subsequent comparison with the bulk supplies made in future at site. However, ultimate choice of the type shall lie completely with the Engineer.		
2.02.03		Chromium plating on fittings and appliances shall be of Grade - 2, (10-micron thickness). Powder coating shall be of approved colour and shall have a minimum Dry Film Thickness (DFT) of 20 Microns.		
2.02.04		All sanitary fittings shall be of heavy duty brass finish with powder coating, unless specified otherwise.		
2.02.05		Stainless steel used for accessories shall be of Grade SS - 304 and from reputed manufacturer (such as SALEM Steel) and shall have polished bright finish.		
2.02.06		Water Closet		
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION	
		i) Wall mounted coloured glazed vitreous china European water closet with dual flush system for flushing solid waste and liquid waste. ii) White glazed vitreous china Orissa pattern WC pan with dual flush system for flushing solid waste and liquid waste.	
2.02.07	Urinals	White glazed vitreous china flat back lipped urinal fitted with photo voltaic control for flushing system with white glazed vitreous china partition of standard size.	
2.02.08	Wash basins	Coloured glazed ceramic oval shaped wash basin fitted with photo voltaic system for water control.	
2.02.09	Mirror	Mirror shall be of superior float glass, edge mounted with teak beading and minimum 12mm thick plywood backing. The size of the mirror shall be 600 mm x 900 mm. It shall be uniformly silver plated at the back and shall be free from any silvering defects. Silvering shall have a protective uniform covering of lead paint.	
2.02.010	Towel rail/ ring	Towel rail (minimum 20mm diameter and 600mm long)/ towel ring (minimum 150mm diameter) and supporting brackets (Stainless steel) shall be fixed in position by means of steel expansion fasteners.	
2.02.011	Toilet paper holder	The toilet paper holder shall be of vitreous china and of size and design as approved by the Engineer. It shall be fixed in position by means of oxidized screws and expansion steel fasteners embedded in the wall.	
2.02.012	Shower Rose	The shower rose shall be of fancy type adjustable multi - spread spray with rotating / adjustable type arm. It shall have uniform perforations. The inlet size shall be 15mm.	
2.02.013	Liquid soap dispenser	Push type metallic liquid soap dispenser shall be provided.	
2.02.014	Sinks	Stainless steel sink with in-built drain board shall be provided for pantry block.	
2.02.015	Waste fittings	The waste fittings shall be provided for wash basin and sinks.	
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION		
2.02.016	Inlet Pipes			
	For inlet connecting pipes to appliances / fittings, powder coated brass pipe of 15mm nominal bore, with union of approved make shall be used. For building sanitary works above ground level, sand cast iron / pipe fittings and accessories shall be used. Pipes shall be coated with two coats of ready mixed black bituminous paint.			
2.03.00	Working Drawings			
2.03.01	The working drawings shall be prepared by the contractor and approved by the Engineer. The drawings shall contain list of all fixtures and fittings along with colour, make, size, dimensions, levels, plumbing details, etc.			
2.03.02	Working drawings shall also give the bill of material with appropriate unit i.e. Quintal, Kgs., Nos. (each), Running Meters, etc., as relevant for all fixtures and fittings.			
2.04.00	Fixing (Installation) of Sanitary Fixtures and Fittings			
	All sanitary fittings and fixtures shall be installed in best workman like manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to wall and floors. All cuttings in walls and floors shall be made good by the contractor. Sanitary pipe shall be routed below the slab. Photo - voltaic systems for water flushing shall be installed by expert agencies wherever provided.			
2.05.00	Brick-Bat Coba Water-Proofing			
2.05.01	Horizontal Surfaces:			
	Operations i - existing covering, if any, on slab shall be removed to prepare the surface. Construction joints, if any, shall be raked and cleaned. Cement slurry admixed with water proofing compound shall be spread to fill cracks and other porous areas. Operation ii - 15mm thick cement mortar 1: 4 (1 cement: 4 coarse sand) admixed with waterproofing compound shall be laid over the prepared surface. Operation iii - a layer of brick bats (coba) shall be laid over the mortar layer to get the required gradient for adequate drainage). (a slope of 1 in 48 is considered adequate). The joints between the brick bats shall be between 15-25 mm in width. These joints shall be filled with cement mortar 1:4 (1 cement: 4 coarse sand) admixed with water proofing compound. Curing shall be done for atleast two days. Operation iv - the top shall be finished smooth with 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) admixed with waterproofing compound and marked with 300mm x300mm false squares. Curing shall be done for atleast two weeks.			
2.05.02	Side Wall:			
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Clause No.	WATER SUPPLY, DRAINAGE AND SANITATION			
	Operation i - existing covering, if any, shall be removed and surface prepared upto the required height (a height of 450mm above the top of slab treatment shall be considered adequate). A cement slurry coating admixed with water proofing compound shall be given. Operation ii - the sidewall shall be provided with cement plaster 1:4 (1 cement: 4 coarse sand) 20mm thick admixed with water proofing compound upto the height specified. A vatta (gola) with brick bats shall be made in cement mortar 1:4 (1 cement: 4 coarse sand) admixed with water proofing compound. This shall be topped with a 20mm thick cement plaster admixed with waterproofing compound. Curing shall be done for atleast two weeks.			
2.05.03	Guarantee Bond			
	The main contractor shall guarantee against any leakage of the water proofing work and shall furnish performance guarantee of the same for seven (7) years beyond the defect liability period in appropriate form as decided by the Engineer-In-Charge. A guarantee bond in prescribed proforma shall be submitted by the contractor to the Engineer in charge, which shall also be signed by the specialized agency, and the contractor to meet their liability / liabilities under the Guarantee bond. However, the sole responsibility about the efficiency of water proofing treatment shall rest with the main building contractor. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of the main contractor.			
3.00.00	GALVANISED PIPES			
3.01.00	Material			
3.01.01	For water supply and roof drainage, galvanised mild steel pipe of medium grade conforming to IS: 1239 shall be used. Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall be as per IS: 6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects, as per IS: 2629.			
3.02.00	Laying Installation and Jointing of Pipes and Fittings			
3.02.01	Relevant Indian standard code of practices shall be followed as general guidance for laying, installation and jointing of different types of pipes and fittings.			
3.02.02	For entry of the pipe lines into any building or structure, suitable conduits under the structure or sleeves shall be used to facilitate installation and maintenance of the services.			
3.02.03	Galvanised mild steel pipes shall be used for water supply and rain water down comers. The galvanised mild steel pipes and fittings shall run on the surface of the walls, ceiling or in chase as specified or shown on the drawing. All pipes shall be well secured and supported by adequately strong brackets anchors. Suitable spacer blocks shall be provided against the vertical surface on which the pipe is fixed.			
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Clause No.	WATER SUPPLY, DRAINAGE AND SANITATION			
	Fixing shall be done by means of standard pattern holder bat clamps. To conceal pipes, chasing may be adopted or pipes fixed in the ducts or recess etc., provided there is sufficient space to work on the pipes with the common tools. Union joints shall be provided for all required locations to facilitate maintenance.			
3.02.04	Where directed by the Engineer, a M. S. tube sleeve shall be fixed at a place the pipe is passing through. All pipes and fittings shall be properly jointed and made completely water tight. Burr from the joint shall be removed after screwing.			
3.02.05	For water pipe lines, meticulous care shall be taken to avoid chances of airlock and water hammer. The layout of pipe work shall be such that there is no possibility of backflow towards the source of supply, from any cistern / appliance, whether by syphonage or otherwise. The pipe inside the building shall be concealed in masonry or concrete of the structure. Chases, openings, conduits, as necessary shall be cut or left in the masonry or concrete. Clamps and fittings shall be as per standard practice and as approved by the Engineer.			
3.02.06	The pipes and fittings shall be checked under working pressure. Any joints found leaking, shall be rectified and all leaking pipes removed and replaced. The pipes and fittings shall be tested for a hydraulic pressure of 6 Kgf / Sq. cm.			
3.02.07	All pipes used for water supply should be thoroughly and efficiently disinfected before being taken into use. The method of disinfection shall be subject to the approval of the Engineer. The storage tanks and downtake distribution pipes shall be disinfected together as specified in IS : 2065, using disinfecting chemical. All rain water down comers shall be provided with cowl dome type drain head.			
3.02.08	Galvanised M.S. Pipes shall be jointed by using standard sockets and / or by welding. For welding of pipes, IS:11906 shall be followed. After welding, the welded area shall be coated with zinc rich paint, after proper cleaning and preparation of the surface. Joints between successive lengths of pipe can be jointed by collars according to provisions of IS:1742. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing.			
3.03.00	Working Drawings			
3.03.01	The working drawings shall be prepared by the contractor and approved by the engineer. The drawings shall contain list of all fixtures and fittings along with colour, make, size, dimensions, levels, plumbing details, etc.			
3.03.02	Working drawings shall also give the bill of material with appropriate unit i.e. Quintal, Kgs., Nos. (each), Running Meters, etc., as relevant for all fixtures and fittings.			
4.00.00	CAST IRON PIPE AND RCC PIPE			
4.01.00	Material			
4.01.01	Cement concrete pipe used for sewer and drain shall conform to IS : 458 and shall be of specified Class.			
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION		
4.01.02	Centrifugally cast (spun) iron pressure pipes of class 'LA' conforming to IS:1536 shall be used for under ground applications. The pipe shall have spigot and socket ends. Pipes shall be coated with coal-tar by hot dipping process for both inner and outer surfaces. C. I. fittings shall conform to IS:1538.			
4.02.00	Laying, Installation and Jointing of Pipes and Filling			
4.02.01	In no case, pipes shall be rolled and dropped into trenches. After lowering, pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe and pushed to the distance that it can go. The pipe shall be laid with socket facing the direction of flow of water. The connection to an existing sewer as far as possible shall be done at the manhole.			
4.02.02	Some important aspects pertaining to a few commonly used (Type) pipes are described in the following clauses.			
4.02.03	Unless otherwise shown on the drawing, following minimum gradients of soil and drainage pipes shall be followed for maintaining minimum self-cleansing velocity of 0.75 M / Sec.			
		Diameter (in mm)	Gradient	
		100	1 in 57	
		150	1 in 100	
		200	1 in 175	
		250	1 in 195	
		300	1 in 250	
4.02.04	The pipes and specials shall be handled with sufficient care to avoid damage to them. These shall be lined up on one side of the alignment of the trench socket facing upgrade.			
4.02.05	Cutting of pipes may be necessary when pipes are to be laid in lengths shorter than the lengths supplied. The pipe shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe.			
4.02.06	Drainage and soil pipes shall not be allowed to come close to water supply pipe lines.			
4.02.07	Where soil, waste and ventilating pipes are accommodated in ducts, access to cleaning eyes shall be provided. Connection to drain shall be through a gully with seal cover to guard against ingress of sewer gas, vermin or back flow.			
4.02.08	Cast iron pipes shall be used for above ground sanitary works			
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION	
		Proper ventilation shall be provided in the piping system. The single stack system shall not generally be provided. Pipes shall be provided with floor trap (nahni type), slotted vent cowl, gully trap with cast iron grating as applicable.	
4.02.09		All work for earthwork shall be done as specified elsewhere in this document under relevant items of the schedule of items. Trenches shall be so dug that pipes could be laid to the required alignment and at required depths. Filling of the trench shall not be commenced till the length of pipes therein have been tested and passed. Special care shall be taken to pack under and sides of the pipes thoroughly with selected material. At least 300 mm over the pipe shall be filled with selected earth.	
4.02.010		All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground shall be gas tight. All sewer and drains laid below ground shall be water tight.	
4.02.011		Over ground cast iron pipes shall be provided with lead joint. The spigot shall be centered in the adjoining socket by tightly caulking in, sufficient turns of tarred gasket or hemp yarn to leave unfilled half the depth of socket for lead. When gasket or hemp yarn has been caulked tightly home, a jointing ring shall be placed round the barrel and against the faces of the socket. Molten pig lead shall then be poured into for filling remainder of the socket. Lead shall then be solidly caulked with suitable tools and hammers of not less than 3 Kgs. weight, right round the joint, to make up for the shrinkage of the molten metal on cooling, and shall preferably be finished 3 mm behind the socket face. Lead for caulking shall conform to IS: 782. It is essential that pipes shall be maintained perfectly dry, before lead run joints are made.	
4.02.012		Underground cast iron pipes shall be provided with Tyton's joints. The C. I. Pipe manufacturer's instructions shall be strictly followed in making such joints. Tyton joints shall be made by push on type 'Tyton' rubber gasket shall conform to the specifications as stipulated by the pipe manufacturer. Tools specified by the pipe manufacturer shall be used to secure joints fully.	
4.02.013		Jointing of concrete pipes shall be generally of rigid type. Collar type joints shall be provided. For collar jointing two adjoining pipes shall be butted against each other and adjusted in correct position and alignment. Collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1: 2 (1 cement: 2 sand) rammed completely with caulking tools. Any extraneous material shall be removed from the inside of the pipe and the newly made joints shall be cured.	
4.03.00		Working Drawings	
4.03.01		The working drawings shall be prepared by the contractor and approved by the Engineer. The drawings shall contain list of all fixtures and fittings along with colour, make, size, dimensions, levels, plumbing details, etc.	
4.03.02		Working drawings shall also give the bill of material with appropriate unit i.e. Quintal, Kgs., Nos. (each), Running Meters, etc., as relevant for all fixtures and fittings.	
5.00.00		MANHOLES	
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION			
5.01.00	At every change of alignment, gradient or diameter of drain / sewer line, a manhole or inspection chamber shall be provided. The maximum distance between manholes shall be 30 M except for trunk route (for pipes above 900 mm diameter) where the distance shall be 45 M. Provisions of IS: 4111 (Part - i) shall be followed for construction of manholes.				
5.02.00	Manhole structure shall generally be constructed with RCC. The manhole shall be built on a foundation concrete (1: 4: 8) having a base thickness / wall thickness of 100 mm up to 900 mm depth and a base thickness / wall thickness of 150 mm for depths ranging between 900 mm to 2300 mm. RCC slab shall be provided as shown on the drawings. Grade of concrete shall be as specified in the schedule of items. Shape of RCC manholes shall generally be of rectangular or circular in section as specified in the schedule of items.				
5.03.00	20 mm diameter M. S. Rungs shall be provided in all manholes. Rungs shall be fixed 300 mm apart vertically as well as horizontally and staggered laterally and shall project 100 mm beyond the surface of the wall. The top rung shall be 450 mm below the manhole cover. Projected portion of rungs shall be coated with coal tar and finish painted with two coats of ready mixed black bituminous paint. The portion embedded shall be painted with thick cement slurry before fixing.				
5.04.00	For the portion of manhole below water table, water proofing admixture shall be added in the concrete. Inside concrete surface shall be finished with floating coat of neat cement slurry.				
5.05.00	Unless otherwise specified, 560 mm diameter circular cast iron manhole cover and frame, heavy duty shall be provided. Manhole cover and frame shall be coated with a smooth and tenacious black bituminous base material. The frame of manhole shall be finally embedded to correct alignment and levels in RCC or plain concrete slab. After completion of the work, manhole covers shall be sealed by means of thick grease.				
5.06.00	The channels and benching shall be done in cement concrete M - 20 neatly finished. These shall be semi - circular in the bottom half and of diameter equal to the pipe. Above the horizontal diameter, sides shall be extended vertically 50 mm above the crown of the pipe and top edge suitably rounded off.				
6.00.00	OVER HEAD / LOFT TYPE WATER STORAGE TANK				
6.01.00	Overhead / loft type water storage tank shall be made of polyethylene. These tanks shall be provided for each toilet block and placed on the roof / loft of the buildings with proper supporting arrangements. Bearing contact shall be so as to distribute the load evenly. These tanks shall be leak proof and water tight. The outlet pipe shall be 50mm above the bottom of the tank and provided preferably with copper gauge strainers. Wash out or draining pipe shall be made flush at the bottom of the tank at its lowest point. Floor of the tank shall be given a slight fall to the wash out pipe.				
6.02.00	Polyethylene Water Tanks				
6.02.01	The polyethylene water tanks shall meet the requirements of IS : 12701. Virgin HDPE granules of approved grade, suitable for drinking water shall be used for				
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		making the tank. Carbon black shall be added with the granules. Tank shall have closed top provided with lid. However, for storage inside the building, rectangular loft tank of approved colour shall be provided. Minimum capacity of the tank shall be 500 litres.	
6.02.02		Tank shall be provided with all fittings for inlet, overflow, outlet pipes and ball valves including mosquito proof coupling.	
6.02.03		Tank shall be installed with proper support and anchorage, for applicable wind and seismic conditions. Installation of tanks shall be carried out according to the recommendation of IS: 12701.	
7.00.00		MAKING CONNECTION OF DRAIN AND SEWER LINE WITH EXISTING MANHOLE	
		This shall include the breaking into and making good the walls, floor with cement concrete of specified grade, providing of cement: sand plaster, finishing the same with neat cement, including making of necessary channels.	
8.00.00		SAMPLING, TESTING, ACCEPTANCE CRITERIA AND TOLERANCES	
8.00.01		Frequency of sampling, testing and quality assurance including the method of conducting the tests, acceptance criteria and construction tolerances shall be as given in Part-C of this specification.	
9.00.00		RATES AND MEASUREMENTS	
9.01.00		Rates:	
		This clause shall be read in conjunction with the clause for the unit rate given in Part-A of this specifications.	
9.02.00		Measurements	
		This clause shall be read in conjunction with the clause for the measurements given in Part-A of this specifications.	
9.02.01		The measurement for the item of galvanised mild steel pipes shall be based on the weight in quintals. Pipes shall be measured separately, according to range of diameter of pipes.	
9.02.02		The measurement for the item of oxidised brass stopcocks shall be based on the weight in kgs.	
9.02.03		The measurement for the item of toilet block and pantry block shall be based on numbers of respective items and types.	
9.02.04		The measurement for the item of sand cast iron / cast iron (pressure) pipe / non-pressure RCC pipes shall be based on linear measurement in meters, as laid or fixed from inside of one manhole to the inside of the other manhole / chamber. The length shall be taken along center line of pipes over all fittings, such as bends, junctions, etc. Cement concrete bedding / concrete for haunching or encasement for R. C. C. and C. I. Pipes shall be measured separately, under respective P. C. C. / RCC Work.	
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Clause No.		WATER SUPPLY, DRAINAGE AND SANITATION			
9.02.05	The measurement for the item of manhole shall be based on numbers of respective items and type and shall be enumerated depending upon the type, size and depth. The depth of manhole shall be reckoned from the top level of C. I. cover to the invert level of channel and shall be measured in Cm. All reinforcement work, M. S. rungs shall be paid separately under relevant respective Items of work.				
9.02.06	No separate measurement shall be done for making connection of drain or sewer line with existing manhole, as the same is included under the item of manhole.				
9.02.07	The measurement for the item Brick-Bat coba water proofing shall be based on actual volume of work as executed in cubic meter. No deducts shall be made for volume occupied by fittings and fixtures.				
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	SECTION - 7 STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC.			
1.0.0	INTENT OF SPECIFICATION			
1.1.0	The equipment to be furnished and erected as covered in this specification shall be engineered, designed, supplied, fabricated, tested, transported to site, unloaded and stored at site, erected and commissioned, trial operated and tested for performance and guarantee as per requirements specified herein. The requirements, conditions, appendices etc, stated in special conditions of contract, GCC, for the work regarding equipment/services under this specification shall apply to and shall be considered as a part of this specification as completely as if bound herewith. The words stoplog gate, stoplog or gate used in this specification are synonymous. Similarly, trash rack and trash screens shall be considered synonymous.			
1.2.0	Stoplogs, Trash racks, Lifting beam etc. (excluding hoist) as specified hereinafter shall be offered. Hoisting arrangement are covered in CW equipment package.			
1.3.0	It is not the intent to completely specify all details of design and construction; nevertheless the equipment shall confirm in all respects to high standard of Engineering design and workmanship and shall be capable of operational performance in a manner acceptable to the Owner.			
1.4.0	Equipments and services that have been covered under this Section are also described in the subsequent clauses of this specification and broadly cover the following:			
1.4.1	Item Description a) Stoplog gates with complete lifting arrangement (excluding hoist) above the operating floor of CW & Raw Water pump houses. b) Trash racks with complete lifting arrangement (excluding hoist) above the operating floor of CW & Raw Water pump houses. c) Lifting Beams for handling of Stoplog gates and trash racks of CW & Raw Water pump houses.			
2.0.0	DESIGN CRITERIA			
2.1.0	The responsibility for a safe, adequate and coordinated design shall rest with the contractor. The following design criteria are to be adopted for stoplogs. (i) Stoplog Gates The stoplog gate shall cover a clear opening of sizes, as specified in drawings. The stoplog units shall be designed for a differential water head by considering highest water level or head of water outside and inside sump empty. The stoplog units shall be required to be raised or lowered under balanced conditions except for forces arising due to water current. The stoplogs should be designed for this condition also. The stoplogs shall be operated by means of hoists. All lifting beams shall be able to engage and dis-engage			
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	automatically with stoplogs in required position. Lifting beams shall be designed, fabricated and erected by the Bidder under this contract conforming to IS 13591. The structural design of stoplogs shall conform to IS 5620. The first stage and second stage embedded parts and other structural steel members shall be supplied and installed by the Bidder. Necessary second stage concreting/grouting shall be also under the scope of this contract. (ii) Trash Racks Each set of trash rack shall consist of interchangeable units for CW pump house, and Raw water pump house. The trash rack shall cover a clear opening as specified. The trash rack shall be designed for a differential head of 2.0 m of water column. The structural design shall conform to IS 11388. The first and second stage embedded parts shall be supplied and installed by the Bidder. 3.0.0 SCOPE 3.1.0 The scope of services and the equipments to be furnished and erected under this specification is summarised hereinafter. The items though not specifically mentioned but are needed to make the equipments system complete, shall also be furnished and erected unless otherwise specifically excluded. 3.1.1 The work to be done under this specification shall include all plant, equipment, labour and material required for the performance of all works necessary for design manufacture, supply at the site and complete erection and guarantee tests of the following stoplogs, trash racks, lifting beams etc. <table><tr><th colspan="2">Details</th><th>CW pump house</th><th>Raw water pump house</th></tr><tr><td colspan="4">A. Stoplogs</td></tr><tr><td>i)</td><td>No. of Stoplogs</td><td>2 sets</td><td>2 sets</td></tr><tr><td>ii)</td><td>Clear size of opening</td><td>5600 mm (W) x 5000 mm (H)</td><td>1600mm (W) x 2000mm (H)</td></tr><tr><td colspan="4">B. Trash rack</td></tr><tr><td>i)</td><td>No. of trash racks</td><td>6 sets</td><td>6 sets</td></tr><tr><td>ii)</td><td>Size of clear opening</td><td>5600 mm (W) x 9500 mm (H)</td><td>1600 mm (W) x 10500 mm (H)</td></tr></table>	Details		CW pump house	Raw water pump house	A. Stoplogs				i)	No. of Stoplogs	2 sets	2 sets	ii)	Clear size of opening	5600 mm (W) x 5000 mm (H)	1600mm (W) x 2000mm (H)	B. Trash rack				i)	No. of trash racks	6 sets	6 sets	ii)	Size of clear opening	5600 mm (W) x 9500 mm (H)	1600 mm (W) x 10500 mm (H)
Details		CW pump house	Raw water pump house																										
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CLAUSE NO.	STOPLOG GATES,TRASH RACK AND LIFTING BEAM ETC.				
3.1.2	(i) First and second stage embedded parts and structural steel members including seal seats, tracks, guides, latches for storing of stoplogs etc. complete are included in the scope of supplies / works under this package. (ii) The lifting beam (automatic) for stoplog gates and trash rack (1 no. for each) with side guide shoe, hooks, links and weights etc. complete for automatic operation is included under the scope of supply/services under this package.				
3.1.3	The first and second stage embedded parts and structural steel members shall be supplied by the Bidder. It is the responsibility of the Bidder to install the first & second stage embedments and structural steel members in position and carry out the filling of the blockouts left at the time of first stage concreting with concrete of specified strength to the required line and grade. It will be the responsibility of the Bidder to grout holes and blockouts left after second stage concreting of embedded parts and to finish the concrete surface to the satisfaction of the Owner.				
3.1.4	Preparation of all detailed designs, fabrication drawings, bills of materials, tags and piece numbers, welding procedures, etc. Detailed designs shall be submitted to owner in five sets for review and approval. Owner's approval shall not absolve bidder's responsibility of safety and adequacy of structures and equipments.				
3.1.5	Furnishing all materials, labour, supervision, tools and plant necessary for fabrication, erection, testing, commissioning, trial operation, performance and guarantee tests of stoplogs, including rubber seals, side guide shoes, bronze sliding pad screwed to mild steel slide block base, lifting lugs, trash racks including side and front guides, lifting lugs, etc. including all fittings and accessories in an efficient and expeditious manner. The testing of all materials are also included in Bidder's scope.				
3.1.6	(a) Transit-cum-Storage-cum erection insurance for all equipments and materials covered under this specification. (b) Transportation to site, all loading, unloading, intermediate storage at site & concreting/grouting work is included in the scope.				
3.1.7	Furnishing necessary paints and protective coatings and application thereof at manufacturer's workshop. Painting of all materials supplied and/or erected including final painting at site as per specifications.				
3.1.8	All information and data regarding gates and trash-racks shall be supplied by the Bidder. All supports, anchor bolts, nuts, bolts etc. for the equipment for the portion of the Bidder's scope shall be supplied by the Bidder.				
3.1.9	Complete instrumentation as necessary for efficient operation of the equipment.				
3.1.10	Deleted				
3.1.11	Deleted				
3.1.12	Deleted				
3.1.13	Deleted				
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CLAUSE NO.	STOPLOG GATES,TRASH RACK AND LIFTING BEAM ETC.			
3.1.14	Various, drawings, as-built drawings, reproducible tracing film of the approved drawings, data, test reports, test certificates, erection manuals, operation and maintenance etc. as required.			
3.1.15	Getting approval required from statutory authorities shall be the responsibility of the Bidder.			
3.1.16	All required accessories and auxiliaries not specifically mentioned above but are required for the efficient and economic operation of gates and trash racks shall be furnished.			
3.1.17	The Bidder's designs and drawings shall be compatible with civil drawings. All concreting, final dressing, grouting and patch work during erection shall be in the scope of the Bidder.			
4.0.0	DESIGN AND CONSTRUCTION			
4.1.0	The design and fabrication shall conform to the requirements of relevant latest Indian Standards Specifications published by the Bureau of Indian Standards. If B.I.S. standards are not available, other internationally acceptable standards which ensure equal or higher performance than those specified shall be acceptable and these should be read in conjunction with these specifications.			
4.2.0	The Bidder shall prepare all necessary shop drawings covering the materials to be supplied under these specifications and shall be responsible for the correct fittings of all parts.			
4.3.0	Blockouts			
4.3.1	After the work is awarded, the successful bidder/contractor shall furnish drawings indicating the blockouts to be left in the civil works wherever required. The Contractor shall prepare all necessary shop drawings covering the materials to be supplied under these specifications and shall be responsible for the correct fittings of all parts.			
4.3.2	Unless otherwise specifically provided for in the schedule or specifications or on the drawings, the Contractor shall furnish all the materials, accessories and appurtenant parts required by the specification or shown in the drawing and anything shown in the drawings and not mentioned in the specifications or required by the specifications and not shown in the drawings shall be furnished as if required and shown in one or both.			
4.4.0	Fabrication			
	Any fabrication done before the design and the shop drawings are approved will be at the Bidder's risk. The Owner shall have right to instruct the Bidder to make any change in the design & fabrication details, which may be necessary in the opinion of the Owner to make the finished construction conforming to the requirements and intent of these specifications without additional charges to the Owner.			
4.4.1	Approval of the Owner of the Bidder's drawings shall not relieve the Bidder of any part of his responsibility to meet the requirements of these specifications, or of the responsibility for the correctness of the drawings.			
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CLAUSE NO.	STOPLOG GATES,TRASH RACK AND LIFTING BEAM ETC.			
4.4.2	When the materials for the anchor bolts, structural steel members and embedded parts, gates, trash racks etc., have been fabricated and installed, the Bidder shall furnish the Owner for record purposes five complete sets of the final shop drawings from which they were actually fabricated.			
4.4.3	These drawings shall show all alternatives selected and all changes or revisions made or used in the actual fabrication of the gates and trash racks.			
4.4.4	The Bidder shall also furnish to the Owner, block line details of marking and match marking diagrams in triplicate.			
4.4.5	Dimensions, tolerances, types and grades of materials and various components parts shall be shown in sufficient detail in enable the Owner to make a complete review and thoroughly check the drawings.			
4.5.0	The Bidder shall submit within 15 days after the relevant civil construction drawings are released, detailed designs and working drawings progressively, of all items specified for the approval of the Owner before the manufacture is taken up. Such approval will be given in course of fifteen to 30 days from the date of receipt of the designs and drawings along with the bills of material. Bidder has to supply raw steel and other material for this work.			
4.5.1	If during the course of scrutiny of bidder's design, it becomes necessary to increase the total tonnage of the stoplogs and the allied parts, the same shall be provided by the Bidder without any extra cost to the Owner.			
4.5.2	All the design computations for the structural and mechanical parts and connections of various components shall be submitted by the Bidder for the approval of the Owner. Detailed drawings of mechanical parts shall also be supplied along with calculations.			
4.5.3	It is, however understood that the Bidder accepts the full responsibility for the successful operation of the gates and trash racks and other equipments supplied by him.			
4.5.4	The gates shall be designed to eliminate vibration and to operate smoothly under all operation conditions.			
4.5.5	The design and design stresses etc. shall be up accordance with IS 5620, and other relevant IS specifications.			
4.6.0	Job Requirements The Bidder shall give his designs for the stoplogs, trash racks, embedded parts etc. based on specification and drawings and submit in quintuplicate detailed designs and drawings for approval of Owner. The designs, however, shall conform to these specifications and specification drawings in all respects.			
4.6.1	Any variation from these specifications will not be permitted without prior approval of the Owner.			
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4.6.2	The Bidder shall furnish such other parts and accessories not explicitly shown on the drawings or mentioned in the specifications, if such parts are essential in the Owner's opinion for satisfactory performance of the equipment without any extra cost to the Owner.			
4.6.3	Upon the completion of contract but before the payment of the final bill the Bidder shall furnish the Owner four sets of all drawings in hard copy and two (2) sets of soft copies in AutoCAD format for each drawing showing details of all parts, assemblies with alternatives or authorised changes that have been used and approved by engineering.			
5.0.0	INSPECTION AND TESTING AND MANUFACTURER'S WORKSHOP			
5.1.0	All equipment covered under this specification shall be subjected to inspection by Owner during manufacture at Works and these tests shall be conducted in accordance with the conditions specified in the conditions of contract.			
5.1.1	Shop tests shall include all tests to be carried out at Bidder's works, works of sub-Contractor(s) and at Works where raw materials are supplied for manufacture equipment. The tests to be carried out shall include but not be limited to the test described below.			
5.2.0	Manufacturer/Supplier shall conduct all tests according to relevant I.S. or according to relevant British/American code of practice in the absence of suitable I.S. Code to ensure that all the components and accessories of stoplogs & trash racks to be supplied as per this contract shall conform to the requirements of this specification.			
5.2.1	Tests for gates, components etc. and bought-out items shall be conducted in presence of the Owner's inspectors.			
5.3.0	The Bidder shall clearly indicate in his proposal, the facilities available in his shop to conduct the performance tests.			
5.4.0	The accessories, e.g. bearings, couplings etc. will be subjected to tests as per Manufacturer's standard. The applicable tests reports/certificates shall be submitted to Owner.			
5.5.0	Deleted			
5.6.0	Tolerance in dimensions shall be within the limits as prescribed in the relevant I.S. Codes and standards, if not mentioned otherwise in this specification.			
5.7.0	Surface defects shall be removed as required by the relevant standards. All local repair, grinding or machining shall be smoothly blended into the surrounding faces.			
5.8.0	For all material covered under this specification, the proof in the form of certified test reports or mill certifying that the required tests (as per the specified standards) have been carried out at the source shall be submitted, but if these are not available, the tests shall be performed by the Bidder at his own expense.			
6.0.0	TRANSPORTATION			
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CLAUSE NO.	STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC.				
6.1.0	The Bidder shall arrange to transport equipment to the site of works. All tools and tackles, tractors, trailers, crane for loading and unloading, handling and transport of fabricated members to site and then to site of erection shall be provided by the Bidder. Each part of stoplog gates, trash racks, embedded parts, guides etc. which is to be transported as a separate piece shall be marked to show the unit of which it is a part and match marked to show its relative position in the unit to facilitate assembly in the field. Unit marks and match marks shall be made with heavy steel stamps and paint. Each piece, sub-assembly or package transported separately shall be labeled or tagged with transportation designation consisting of the specifications number of such piece or the number of parts grouped in such sub-assemblies or contained in the package.				
6.2.0	Weighing Before transportation, the Bidder shall determine by the most accurate means available, net weight of each piece of assembly that is to be transported as a unit and such net finished weights exclusive of boxes, crates or skids shall be furnished to the Owner and shall be painted on the respective pieces or assemblies or stated on tags attached there to.				
6.3.0	Preparation for Transportation All parts shall be prepared for transportation so that slings for handling may be attached readily whenever the parts are to be moved. Where it is unsafe to attach slings to the box, boxed parts shall be packed with slings attached to the part and the slings shall project through the box or create so that attachments can be made readily. All exposed finished surfaces shall be adequately protected against abrasion during transportation and all long and slender pieces shall be adequately supported and blocked. Rubber seals shall be dismantled after shop assembly and shall be transported separately. They shall be wrapped and boxed to protect them from any element which would adversely affect their size, shape or physical properties before they are field assembled to the gates. The equipment shall be prepared for transportation so as to permit minimum amount of field assembly.				
7.0.0	PACKING The Bidder shall include and provide for accurately protecting and packing the equipment so as to avoid loss or damage during transportation by sea, oil or road. All packing show allow for easy removal and checking at sites. Special precautions shall be taken to prevent rusting of steel and iron parts during transit by sea. Suitable method proposed to be adopted for protection against moisture shall be subject to the prior approval of the Owner. Each bale or package shall contain number and date of contract order and the name of the office placing the order. After delivery of the material at site all packing shall become the property of the Owner. Notwithstanding anything stated in these clauses, the Bidder shall be entirely responsible for loss, damage or depreciation to the stores due to faulty and insecure packing. The equipment shall be insured for loss or damage during transit at the cost of the Bidder.				
8.0.0	ERECTION AND COMMISSIONING				
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CLAUSE NO.	 STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC. 			
8.1.0	Erection Procedure The Bidder shall be required to furnish all erection drawings. The Bidder shall prepare a complete erection procedure which shall describe the sequence of operations to be carried out, the methods to be used, the measurements to be taken and the tolerance to be met in the erection and alignment of the above equipment. Such procedure shall have the prior approval of the Engineer. The equipment shall be installed under the supervision of erection personnel to be provided by the Bidder and the Bidder must assume full responsibility for the erection and satisfactory operation of the equipment.			
8.2.0	Installation of Stop-Log Gates, Trash Rack etc.			
8.2.1	Assembly and erection frames, guides, tracks and seals seat arrangement shall be assembled in the respective block-outs, brought to line, grade and plumb within the erection tolerance and secured in place by anchorages as shown on the drawings or otherwise according to the best modern practice and as necessary for successful functioning of these units.			
8.2.2	The erection tolerance for the frames and guides shall be as indicated in the drawings and shall be as per IS 5620. Extreme care shall be taken to ensure that their surfaces are in true planes within the tolerance (as stated above) throughout their entire length; otherwise, serious damage to the gates may result during operation.			
8.2.3	Assembly shall be done by bolting and welding and connections to embedded anchorages shall be adjusted and finally tightened to hold the guides securely in position while concrete is being placed in the blockouts.			
8.2.4	Placing Concrete in Blockouts shall be done by the Bidder. Before placing the concrete in any one lift and between placement of successive lifts, alignment tolerances shall be checked and remedial action shall be taken if any displacement has occurred. The blockout concrete mix shall conform to Grade M30 as per IS 456 (latest edition). Concrete works shall be paid separately as per the Schedule of Quantities of this tender document.			
8.2.5	Adequate dowels should be provided to ensure firm bonding with the main RCC structure.			
8.3.0	Field Tests & Acceptance After the equipment has been installed in the field, it will be operated and tested by the Owner and when so operated and tested it shall meet all the requirements of the specifications and drawings. The gates shall be raised and lowered several times for their full length of travel. The primary requirement for acceptance shall be that each gate operates smoothly and guarantees satisfactory water tightness. Leakage tests shall be carried out with the stoplog gate lowered on the sill. Before the observation for leakage, the stoplog gate shall be raised and lowered about one meter several times in order to dislodge any debris that might have lodged in the side and bottom seals. The leakage then shall be measured and it should not be more than 5 litre/min/metre length of seal under maximum head. On successful completion of such tests and after satisfying the equipments being according to specifications, final			
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		acceptance shall be given by the Owner. Bidder shall also give a guarantee for the satisfactory operation of gates and trash racks for a period of minimum one year after the completion of the contract.		
9.0.0	INSPECTION AND TESTING AT SITE			
9.1.0	The stoplog & trash rack shall be tested as indicated in the relevant Indian Standards.			
9.2.0	All equipments required for inspection and testing shall be provided by the Bidder and no such equipment shall be supplied by the Owner			
9.3.0	Where complete penetration and complete fusion is specified for welds, quality of welds shall be checked by the radiographic method according to applicable standards.			
9.4.0	All defects detected during testing shall be repaired to the satisfaction of the Engineer.			
9.5.0	After completion of all installation, the frames and guides etc. shall be thoroughly cleaned of dirt, dust, rust and concrete spills or other foreign materials.			
9.6.0	The gates shall be thoroughly cleaned with particular attention being paid to bearing and sealing surfaces and the painting/coating shall be repaired wherever necessary.			
9.7.0	Deleted.			
9.8.0	Each set of stoplog and trash racks shall be tested under dry conditions and under full water load conditions, by traversing the item concerned from its extreme raised position to full seating position and return at atleast thrice.			
9.9.0	Minor adjustment necessary to affect satisfactory closure in the seated position shall be made wherever required.			
9.10.0	Upon successful completion of such tests, final acceptance shall be made by the Owner.			
10.0.0	But before a completion certificate is issued by the Owner the Bidder shall have to remove from the area of operation, on which the work has been executed all scaffolding, surplus materials, rubbish and other materials.			
10.0.1	If the Bidder fails to comply with this requirement, the Engineer shall get it done by other agencies at Bidder's cost.			
11.0.0	SHOP AND FIELD PAINTING			
11.1.0	General			
	All paints and painting materials required for the field and shop painting shall be supplied by the Contractor and shall be included in the quoted price.			
11.2.0	Painting Specification for Structural Steel parts for stoplog gates and trash racks:			
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	All surfaces of the embedded parts which are to come in contact with concrete shall be cleaned and given two coats of cement latex wash to prevent rusting during shipment and while awaiting installation. All unfinished surfaces of the embedded parts exposed to weather or water, stoplog gates and trashracks shall be cleaned by sand or grit blasting and painted as given below; (i) All structural steel surfaces shall be cleaned by sand or grit blasting to uniform base metal finish to SA 2.5 or as specified in IS9954. (ii) Deleted (iii) After sand blasting 2 coats of zinc rich epoxy primer to obtain a dry film thickness (DFT) of 50 microns (for 2 coats) (iv) Over primer coat, two coats of coal tar Epoxy paint having minimum 75 to 100 micron DFT / coat. (v) Total minimum DFT = 200 microns of Epoxy paint. 12.0.0 Lifting beams shall be painted as per provisions for painting of structural steel as specified in Section-3 of Technical Specification. 13.0.0 SPECIAL TOOLS AND TACKLES 13.1.0 The Bidder shall furnish to the Owner a complete and unused set of all special tools and tackles, which are necessary or convenient for erection, commissioning, maintenance and over-hauling of any of the equipment provided under the specification. 13.2.0 The tools shall be shipped or transported in separate containers clearly marked with the name of equipment for which they are intended. 13.3.0 The Bidder shall furnish a list of such tools included under the scope of supply with the proposal. 14.0.0 SAFETY PRECAUTIONS 14.1.0 The Bidder shall strictly follow at all stages of fabrication, transportation erection of steel structures, raw materials and other tools and tackles, the stipulations contained in the Indian Standard Safety Code for erection of structural steel work IS 7205. 14.2.0 Local statutory labour safety regulations are also applicable. 15.0.0 MEASUREMENT Stoplogs shall be measured in terms of areas of clear-cut openings in the concrete structure for which the gates and the trash racks have been provided multiplied by the number of gates supplied. All the other components as specified above and in other sections herein of this module for the stoplogs shall be deemed to be a part of the stoplogs/trash racks/lifting beam and shall not be measured separately except specified otherwise. The size of the stoplogs is tentative and shall be finalized based on the pump characteristics. The payment shall be regulated based on the proportionate area of the opening of the stoplogs e.g. Actual price payable = Quoted price x (A2/A1)^{0.7} where A1 = Area of opening based on size mentioned in BOQ and A2 = Area of opening based on adopted size of opening			
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16.0.0	RATE Rate quoted by the Bidder should be for the supply fabrication, transportation and erection of all components and for execution of complete work including successful commissioning as specified in the Specification given in this section herein for the respective item. Mono-rail beam and its supporting structures shall be paid separately under structural steel works as per Schedule of Quantities.															
17.0.0	TERMS OF PAYMENT Following terms of payment shall be applicable: <table><tr><td>(a)</td><td>On fabrication and erection of gates including embedments</td><td>70% of Quoted Price</td></tr><tr><td>(b)</td><td>On successful commissioning of gates</td><td>20% of Quoted Price</td></tr><tr><td>(c)</td><td>Release of retention money as per terms of contract</td><td>10% of Quoted Price</td></tr></table> The above terms of payment shall be applicable for trash racks also.				(a)	On fabrication and erection of gates including embedments	70% of Quoted Price	(b)	On successful commissioning of gates	20% of Quoted Price	(c)	Release of retention money as per terms of contract	10% of Quoted Price			
(a)	On fabrication and erection of gates including embedments	70% of Quoted Price														
(b)	On successful commissioning of gates	20% of Quoted Price														
(c)	Release of retention money as per terms of contract	10% of Quoted Price														
18.0.0	STOPLOG GATES															
18.1.0	MATERIALS AND MANUFACTURE															
18.1.1	Materials Material Specifications: All materials used in the fabrication of stoplog gates required under this invitation shall be new and shall conform to the specifications specified, herein. If a material is specifically not referred to in these specifications / specification drawings, bidder shall furnish material of the highest standard, commercial quality suitable for the intended use. If for any reason, the Bidder desires to deviate from the standards designated in these specifications or in drawings, statement to the effect stating exact nature of the deviation(s) or substitution(s) in a part of or complete specifications for the materials which are proposed to be used, shall be submitted by the contractor for approval. The material(s) referred to in the design and drawings mostly conform to Indian Standard Specifications unless otherwise stated.															
18.1.2	Materials for the various components of stoplog gates: <table><tr><th>Sl. No.</th><th>Component/Part material</th><th>Recommended</th><th>Reference</th></tr><tr><td>1.</td><td>Stoplog gate leaf</td><td>Structural Steel</td><td>IS 2062</td></tr><tr><td>2.</td><td>Stoplog gate frames, 1st stage embedded parts and structural steel members</td><td>Structural Steel</td><td>IS 2062</td></tr></table>				Sl. No.	Component/Part material	Recommended	Reference	1.	Stoplog gate leaf	Structural Steel	IS 2062	2.	Stoplog gate frames, 1 st stage embedded parts and structural steel members	Structural Steel	IS 2062
Sl. No.	Component/Part material	Recommended	Reference													
1.	Stoplog gate leaf	Structural Steel	IS 2062													
2.	Stoplog gate frames, 1 st stage embedded parts and structural steel members	Structural Steel	IS 2062													
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CLAUSE NO.	STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC.				
	3.	Slide Block	Structural Steel base With Bronze Pad	IS 2062 IS 305	
	4.	Sliding Track	Corrosion Resistant Steel	IS 1570	
	5.	Seals	Rubber	IS 11855	
	6.	2 nd stage embedded parts	Structural Steel	IS 2062	
	7.	Fasteners	Stainless Steel	IS 1570 Part V Gr 04Cr19Ni9	
	8.	Seals seats	Stainless Steel	SS 316L or IS 1570 (Part- 5)	
	9.	Lifting pins	Stainless Steel	SS 316L or IS 1570 (Part- 5)	
	10.	Guide	Corrosion resistant steel	IS 6603	
	11.	Guide Shoe	Structural Steel	IS 2062	

	For all the IS codes specified, latest editions should be followed.				
18.2.0	Manufacture				
18.2.1	General Workmanship				
All fabrication work under this contract shall be done in accordance with the specifications which meet the Owner's approval. All work shall be performed and completed in a thorough workman like manner as per latest practice in the manufacture and fabrication of materials of the type covered by these specifications. The work shall in all cases be of the highest quality and carefully performed to the satisfaction of the authorised representative of the Owner. The Bidder shall warrant all material and workmanship furnished by him to be free from injurious defects. He shall replace, free of cost to the owner, any defective material or workmanship noticed during erection and shall bear all cost(s) of the modifications of any defect for which he is responsible. Workmanship shall conform to the latest standards laid down in Indian Standards specification or I.R. specifications (in case IS is not available).					
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CLAUSE NO.	STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC.				
18.2.2	All members shall be free of twists, bends or other deformations and all surfaces that will be in contact shall be thoroughly cleaned before assembling. Parts shall be adjusted to line and fit and shall be firmly bolted or otherwise held securely together so that surfaces are in close contact before drilling, reaming or welding is commenced. Plates with laminations discovered during cutting, welding or at any other time shall be rejected. Minor surface imperfections can be repaired wherever possible with the prior approval of the Engineer. Materials not supplied or workmanship not performed in accordance with approved drawings or specifications shall be rejected, removed and replaced. If the weight limitations and transport clearances do not permit, the gates anchorages and miscellaneous embedded parts shall be fabricated into sub-assemblies. All the parts of the gates shall be fabricated in accordance with these specifications and drawings. The Bidder shall take special care in fabrication of all parts affecting strength, rigidity and water tightness of the gates. Attention is directed to the fact that rolled edge plates are not suitable for caulking. The seal bases shall be finished after the plates have been welded to the gates and the finished surfaces of the seal bases shall be in the same plane within a tolerance of +/- 0.4 mm in 3 M length without offsets or gaps at joints. Vertical seal seats shall be plumb within + 1.5 mm in overall length. The Bidder may submit for the approval of the Owner an alternative procedure for finishing the seal bases or for fastening them to gates provided that the suggested method produces a water-tight seal arrangement and that the final shape and size of plates meets the dimensional and tolerance requirements shown on the drawings or stated in these specifications. Holes for the wheel pin shall be bored and counter bored in pairs to a common axis, after the gate leaf has been assembled and all the shop welding has been completed. The axis of these holes shall be in a common plane which shall be parallel to the finished surface of the seal bases within a tolerance of + 0.4 mm. The seal rings provided in the wheel assembly shall be products of established manufacturer and must be completely water tight. All holes shall be accurately spaced cylindrical and perpendicular to the members. All counter sinking shall be true and square with holes. The surface of the sliding pad and seal base shall be machined after the gate leaf has been assembled and all the shop welding has been completed.				
	Fabrication of Structural Steel:				
	Structural steel work for the gates shall conform to the requirements stipulated under Section-3 "Fabrication and Erection of Structural Steel Works" of this document.				
	Embedments				
	All embedments for the stoplog gates / trash rack shall be provided as per design to match with civil construction programme				
18.3.0	Inspection and Testing Requirements				
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CLAUSE NO.	एनडीसी NTPC STOPLOG GATES,TRASH RACK AND LIFTING BEAM ETC.																														
	(i) All materials used shall be tested for physical and chemical properties as per relevant codes. (ii) Dye penetration test on welds shall be carried out. Welds shall be tested as per relevant IS codes. All butt joints shall be tested 100% with radiography / X-ray tests. (iii) Casting and forgings shall be subjected to ultrasonic tests. (iv) Rubber seals shall be tested for Shore Hardness, Tensile Strength, Hydraulic Stability Test, Ozone Resistance Test and Aging test.																														
19.0.0	TRASH RACKS																														
19.1.0	Materials, Manufacture and Design																														
19.1.1	Material Specifications: All materials used in the fabrication of equipment required under this invitation shall be new and shall conform to the requirements of special conditions, drawings and the requirements of the standard specifications referred herein. If a material is specifically not referred to in these specifications/specification drawings, Contractor shall furnish material of the highest standard commercial quality suitable for the intended use. The material referred to in the design and drawings mostly conform the Indian Standard Specifications unless otherwise stated: Materials for Trash Racks <table><tr><th>S.No.</th><th>Component/Part</th><th>Recommended material</th><th>Reference</th></tr><tr><td>1.</td><td>Trash rack and 1st stage embedded parts</td><td>Structural Steel</td><td>IS 2062</td></tr><tr><td>2.</td><td>Slide block</td><td>Stainless Steel</td><td>SS 316 L or IS 1570 (Part - 5)</td></tr><tr><td>3.</td><td>Track base</td><td>Structural steel</td><td>IS 2062</td></tr><tr><td>4.</td><td>Track</td><td>Stainless steel</td><td>SS 316 L or IS 1570 (Part - 5)</td></tr><tr><td>5.</td><td>Guides</td><td>Corrosion resistant steel</td><td>IS 6603</td></tr><tr><td>6.</td><td>2nd stage embedded parts</td><td>Structural Steel</td><td>IS 2062</td></tr></table>			S.No.	Component/Part	Recommended material	Reference	1.	Trash rack and 1 st stage embedded parts	Structural Steel	IS 2062	2.	Slide block	Stainless Steel	SS 316 L or IS 1570 (Part - 5)	3.	Track base	Structural steel	IS 2062	4.	Track	Stainless steel	SS 316 L or IS 1570 (Part - 5)	5.	Guides	Corrosion resistant steel	IS 6603	6.	2 nd stage embedded parts	Structural Steel	IS 2062
S.No.	Component/Part	Recommended material	Reference																												
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CLAUSE NO.	 STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC. 			
	7.	Fasteners	Stainless Steel	IS 1570 Part V Gr.04Cr19Ni9
19.2.0	Manufacture			
19.2.1	Workmanship, Defective Work and Material			
	All work shall be performed and completed in a thorough work man like manner equal to the best modern practice in the manufacture and fabrication of material of types covered by these specifications. The work shall be in all cases, of high grade and carefully performed to the satisfaction of the authorised representative of the Owner. The Contractor shall warrant all materials and workmanship furnished by him to be free from injurious defects. He shall replace free of cost to the Owner any defective materials or workmanship discovered during erection and shall bear all costs of modification(s) in the field for which he is responsible. Workmanship shall conform to the latest standards laid down in Indian Standard Specifications.			
19.3.0	Design			
	Trash rack should be designed for 2.0m differential head and the structural members shall be designed as per IS 11388. Each unit of trash rack shall consist of vertical flats and horizontal flats. The grating shall be pressure locked. Size of opening shall be 100 mm x 100 mm for all trash racks. All trash rack should be capable of being lowered in the associated stoplog gate grooves to enable drawal of clean water while a particular track rash is raised for cleaning purposes.			
19.4.0	First Stage Embedments			
	First stage embedments for the trash rack shall be provided as per design to match with the civil construction programme.			
19.5.0	Inspection and Testing Requirements			
	i) All material used shall be tested for physical and chemical properties as per relevant codes. ii) Dye penetration tests on welds shall be carried out.			
19.6.0	Minimum Thickness of Rubber Seal			
	Minimum thickness of rubber seal for stoplogs shall be 14 mm.			
20.0.0	LIFTING BEAM			
20.1.0	CODES AND STANDARDS			
	The design, manufacture, shop testing, erection, testing at the site of lifting beam shall conform to the latest revision of IS 13591 (any other international standards if followed shall meet the requirements called for in the latest			
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CLAUSE NO.	STOPLOG GATES, TRASH RACK AND LIFTING BEAM ETC.			
	revisions of relevant Indian Standards or shall be superior) subject to any modification and requirement specified hereinafter.			
20.2.0	Design Features The main components of the lifting beam shall be as required with location pins and hooks on each side capable of inward and outward rotation. The lifting beam shall be of automatic type capable of engaging and disengaging automatically with stoplogs & trash racks in required position.			
20.2.1	Separate lifting beams shall be used for the operation of stoplogs and trash racks for lifting and lowering.			
20.3.0	Testing (i) All material shall be tested for physical and chemical properties as per relevant codes. (ii) The lifting beam shall be load tested at manufacturer's workshop as well as at site for twice the normal design load with all possible motions without showing any signs of defection. The lifting beam shall be tested for locking and unlocking of stoplog under water. (iii) Dye penetration test for welds shall be carried out. (iv) Ultrasonic test on plates above 25 mm thickness shall be carried out for built up sections.			
21.00.00	TECHNICAL INFORMATION, DRAWING, DATA TO BE SUBMITTED FOR APPROVAL AFTER AWARD OF CONTRACT			
21.01.00	Owner's requirement of information, drawings and data from the successful Bidder after finalisation of contract in respect of equipment covered under Stoplogs, trash racks and Lifting beam are indicated in this Section. These drawings and data shall be submitted by the successful Bidder in six (6) copies to the Owner. These drawings and data shall be furnished by the contractor at the earliest to enable the Owner to complete the detailed engineering to suit the time schedule.			
21.02.0	FOLLOWING DETAILS SHALL BE FURNISHED: (i) GA drawing showing dimensional outline drawings of stoplogs, trash racks, electrically operated hoists, and lifting beam offered. (ii) Structural Design calculation for all components. (iii) Drawings showing internal details of construction for various components with bills of materials. (iv) Drawings showing details of embedded metal parts and other structural steel members.			
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CLAUSE NO.	STOPLOG GATES,TRASH RACK AND LIFTING BEAM ETC.			
21.03.00	Detailed procedures of testing of stoplog gates and lifting beam shall be submitted to the Owner for approval before performance of tests.			
21.04.0	Following test certificates/test curves/data shall be furnished			
	(i) Material test certificate			
	(ii) Test results of protective coatings / linings.			
	(iii) Non-destructive test results as applicable.			
21.05.0	INSTRUCTION MANUALS			
	(i) Instruction manuals presenting the following categories of information for the operation and/or maintenance personnel, shall be furnished.			
	(a) Instructions for initial installation.			
	(b) Recommended inspection points and periods of inspection			
	(c) Instruction for operation of stoplog Gates, electrically operated hoists & lifting beam.			
	(d) Instructions for maintenance and repair.			
	(e) Ordering information for all replaceable parts.			
	(ii) The information shall be organized in a logical and orderly sequence. A general description of the equipment including significant technical characteristics shall be included to familiarize operating and maintenance personnel with the equipment.			
	(iii) A "Parts list" shall be included showing part nomenclature, manufacturer's part number and/or other information necessary for accurate identification and ordering of replacement.			
	(iv) Instructions and "Parts list" shall be clearly legible and prepared on good quality paper and bound in durable folders.			
	(v) If a standard manual is furnished covering more than the specific equipment purchased, the applicable model (or other identification) number, parts number and other information for the specific equipment purchased shall be clearly identified.			
	(vi) The instruction manual shall include the list of all special tools and tackles furnished with complete drawings and instructions for use of such tools and tackles.			
	(vii) The instruction manual will need approval of Owner in the same fashion as that for drawings.			
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Clause No.		SPECIAL ITEMS	
SECTION - 8 SPECIAL ITEMS			
1.00.00	GENERAL REQUIREMENT		
1.01.00	Contents This section of the specification covers the technical requirements for earthing mat, composite aluminium panels, pressure relief valves and other similar works at all levels, for all types of work, in all working conditions.		
1.02.00	Codes and Standards		
1.02.01	Some of the relevant applicable Indian standards and codes, etc, applicable to this section of the specification are listed below: (latest Edition) IS 456 Code of practice for plain and reinforced concrete. IS 2974 Code of practice for design and construction of machine (All parts) Foundations. IS 1893 Criteria for earthquake resistant design of structures. IS 73 Specification for paving bitumen. IS 3043 Code of Practice for earthing. IS 9595 Metal arc welding of carbon and carbon manganese steels – recommendations.		
2.00.00	EARTHING MAT (GROUNDING SYSTEM)		
2.01.00	General Requirement		
2.01.01	The general earthing work shall conform to the provisions of Indian Electricity Rules and applicable code of practice for earthing (IS 3043).		
2.01.02	Steel columns of all buildings and supporting structures for boiler, ESP, etc. (as applicable) shall be connected directly to the earthing mat (grid) whether specifically shown or not. Riser shall be provided for connection to each building and supporting structure steel columns. Column joints shall be bonded to make it electrically continuous for acting as vertical riser for upper floors.		
2.02.00	Earthing Mat		
2.02.01	Earthing mat shall be of a mat/grid construction made out of mild steel rod with, electrodes and riser (pigtailed).		
2.02.02	The grid shall be buried at nominal 1-meter depth from finished ground level unless otherwise indicated in the drawings. For crossing any trench or any under ground		
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Clause No.		SPECIAL ITEMS			
		pipe, a minimum earth cover of 300 mm shall be provided over the ground conductor.			
2.02.03		Nominal diameter of M.S. rod shall be 40 mm or as specified.			
2.03.00		Working Drawings			
2.03.01		Contractor shall prepare the detailed working drawings for earthing mat based on the scheme / design / construction drawing given by the engineer.			
2.03.02		Working drawing shall indicate the layout and level of earthing mat, ground electrodes, risers, excavation and backfilling, welding detail placing of mat avoiding fouling with foundation / underground structure etc., alongwith the bill of material, reference to the applicable codes, method of installation, applicable tolerances etc.			
2.04.00		Ground Electrode			
2.04.01		Ground electrode (M.S. rod, 3000 mm long) shall be installed vertically below the mat and connected to ground conductor shown in the drawing and/or as directed by the Engineer.			
2.04.02		Where the ground conductor passes through reinforcement or steel plate, it shall be bonded to the same.			
2.05.00		Riser			
		The riser (pigtails) from ground grid shall consist of M.S. rod and shall project 300 mm above grade/concrete level unless shown otherwise.			
2.06.00		Excavation and backfilling			
		All excavation whatsoever required for laying the earthing mat shall be neatly done and backfilled as soon as the mat is installed. Back filling material shall be compacted in layer to achieve minimum 85% of compaction at optimum moisture content. Surplus excavated material if any shall be disposed off upto a lead of 2 km. outside the plant boundary. Backfilling shall be neatly dressed.			
2.07.00		Bending			
2.07.01		Bending of mild steel rods where necessary will be done preferably by gas heating.			
2.08.00		Welding			
2.08.01		All ground conductor connections shall be made by electric arc welding as per IS 9595.			
2.08.02		All arc welding of 40 mm dia MS rod shall be carried out with low hydrogen content electrode.			
2.08.03		All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. No artificial cooling shall be adopted to cool welded joints.			
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Clause No.		SPECIAL ITEMS	
2.08.04		The welding required for grounding shall serve three purposes: a) Sufficient mechanical strength between the jointing materials: b) Sufficient electrical area for the flow of system short circuit current (welding drawing is subject to Owner's approval) and c) Sufficient electrical area available after commission during the life time of the plant.	
2.09.01		Laying	
2.09.02		Ground mat conductors shall be laid in field to avoid fouling with concrete foundation/ underground structures.	
2.10.00		Bitumen Coating and Primer	
2.10.01		Welded area of riser/pigtails shall be thickly coated with bitumen compound to prevent corrosion. Before applying bitumen compound, two coats of red oxide primer shall be applied.	
3.00.00		PRESSURE RELIEF VALVES (PRVs) AND GRADED FILTER	
		The under-drainage details and PRVs for all channel, forebays and other works shall be as per IS 4558 "Under drainage of lined canals – Code of practice". For the purposes of design, the condition shall be chosen as the subgrade to be impervious and the water table on the formation level of the ground surface in the near vicinity. The under drainage shall be provided below water conveying structures as shown in the construction drawing in which the hydrostatic pressure due to water table can cause uplift and necessary relief from the hydrostatic pressure need to be provided. The longitudinal as well as transverse drains comprising Perforated PVC pipes of specified diameter shall be provided with a grid size not more than 5m X 5m. Notwithstanding above, one pressure relief valves for every 25m² shall be employed for base (horizontal surfaces). The Valve diameter shall not be less than 90mm. Nylon Jali or Geotextile shall also be provided both around the PRV pipe and the PRV housing pipe.	
4.00.00		RATES AND MEASUREMENTS	
4.01.00		Rates	
		This clause shall be read in conjunction with the clause for the unit rate given in Part-A of Technical Specification.	
4.01.01		Rate for Earthing mat shall include supply, excavation, laying of electrodes, risers etc. complete, welding, painting, coating, backfilling complete as per specification and description of item given in Schedule of Quantities.	
4.01.02		Rate for Pressure Release Valve (PRV) shall include design, supply installation, testing as per Specification. Rate for Perforated PVC pipes shall be inclusive of supply and laying of Nylon Jali or Geotextile around PVC pipes and PRV housing.	
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Clause No.		SPECIAL ITEMS			
4.02.00	Measurements				
4.02.01	This clause shall be read in conjunction with the clause for the unit rate given in Part- A of Technical Specification.				
4.02.02	Earthing mat shall be measured on the basis of the calculated weight of steel actually laid in tonnes. Excavation and backfilling shall not be measured, as the same is included in the rate of item.				
4.02.03	Pressure Release Valves (PRV) shall be measured and paid in numbers. Filter around PRVs and perforated PVC shall be measured and paid separately under relevant item.				
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CLAUSE NO.	 Quality Assurance for Civil Works 				
	QA CIVIL WORKS				
1.0	SAMPLING AND TESTING OF CONSTRUCTION MATERIALS (frequency of sampling and testing -as per relevant IS code, all standards and codes employed or referred to shall be the latest version/ issue in effect) a) Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as soil, fine and coarse aggregates, cement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCCBM-Ballabgarh, CSMRS-Delhi, IIT's, etc. as agreed by the Employer. The test samples (sampling is to be conducted as per relevant latest standard/s) as per for such full-scale testing shall be jointly sampled and sealed by the Employer and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance department (FQA) representative of the Employer. No construction material shall be used unless it is conforming to the specification and has been approved by the Employer. Format for sampling and testing of cement, coarse aggregate, fine aggregate, chemical admixture, fly ash, water, concrete mix design is enclosed at Annexure-I. b) The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the Engineer-in-charge (EIC)/Head of Field Quality Assurance (FQA) Department of Employer.				
2.0	LABORATORY AND FIELD TESTING a) The field laboratory for QA and QC activities shall be established and installed with the adequate facilities to meet the requirement of envisaged day to day tests during execution of the work. Temperature and humidity controls shall be available wherever necessary during testing of samples. The contractor shall furnish a comprehensive list of testing new equipment/ instrument required to meet the planned/scheduled tests for the execution of works for EIC acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&QC manpower in well advance prior to the planned test activity. The tests which cannot be carried out/do not have facilities for testing in the field laboratory shall be done at Employer acceptable third-party testing laboratory. b) All equipment and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the EIC. The calibration certificates shall specify the fitness of the equipment and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipment and instruments by NABL or such accrediting agency complying with ISO/IEC-17025 accreditation and the calibration reports shall be submitted to EIC for their review and acceptance.				
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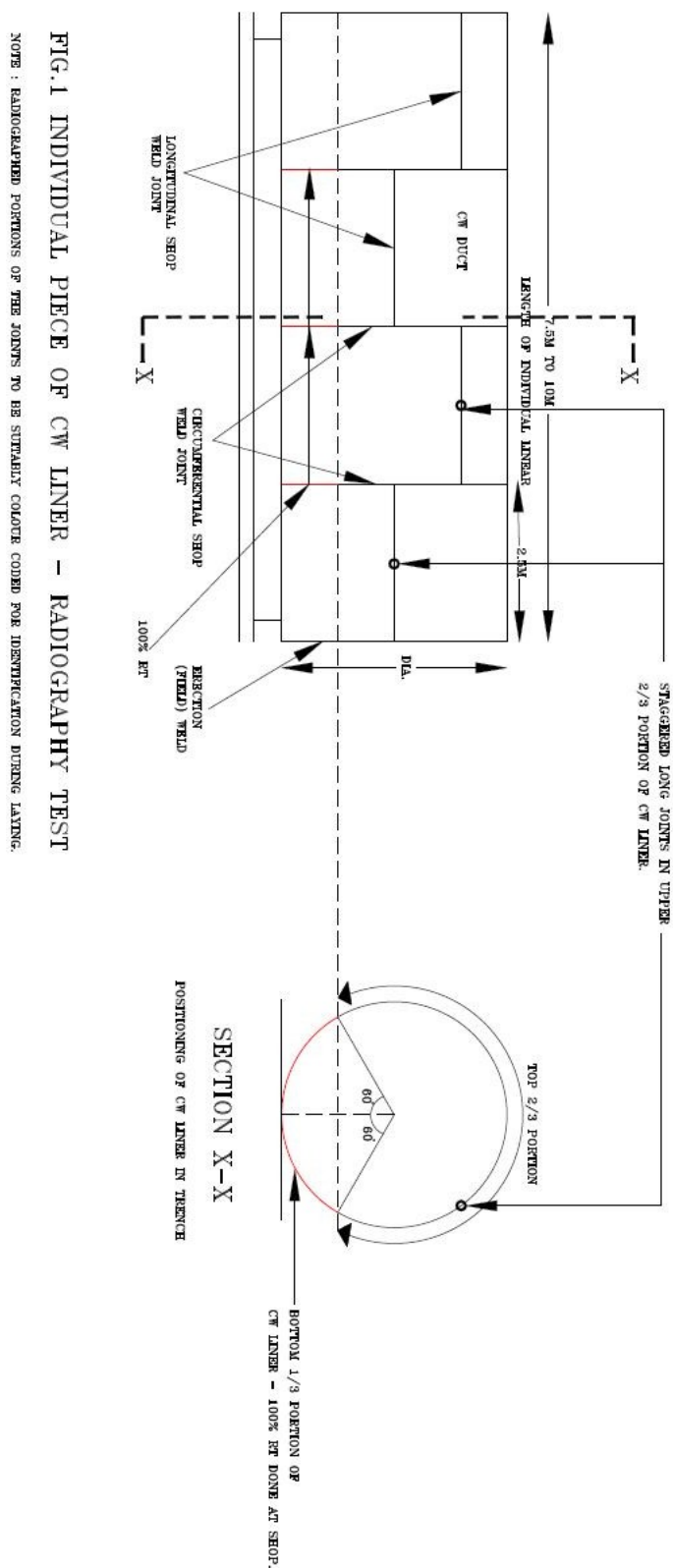
CLAUSE NO.	Quality Assurance for Civil Works			
3.0	</			

CLAUSE NO.	 Quality Assurance for Civil Works 			
4.0	PURCHASE AND SERVICE a) To facilitate advance planning of material testing/ approval of bought out items (BOI), well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the EIC for his approval before bulk procurement. In case of manufacturers test certificate (MTC) is submitted for acceptance and duly approved by EIC, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items (BOI) shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested at the Employer acceptable third-party lab. Approval of material / sample by the Employer shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material. b) Structural steel (plates and rolled sections i.e. channels, beams & angles) conforming to IS 2062 and Reinforcement steel conforming to IS 1786 supply if in the scope of the contractor shall be procured from Primary Steel Producers (Refer NOTE below). Currently, Primary Steel Producers acceptable are SAIL, JSW Steel Ltd, Jindal Steel & Power, Tata steel Ltd. (for Reinforcement steel/TMT bars), RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Arcelormittal Nippon Steel India Ltd. (for Flat products/ Steel Plates), ESL Steel Ltd. (for Reinforcement steel/TMT bars) and JSW Ispat Special Products Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars). Subsequently, if any new Primary Steel Producer/s are proposed during execution of contract, the same may be considered for acceptance subject to meeting the following qualifying requirements: - The proposed supplier should be a Primary Steel Producer, having a minimum production capacity of one million tons per annum (MTPA). - The proposed supplier should be a regular manufacturer of Steel Plates and / or Rolled Sections and / or Reinforcement Steel for the last two years as on date of submission of proposal. - The proposed supplier should also be a registered licensee with Bureau of Indian Standards for BIS:1786/2062 at the time of submission of proposal. NOTE: The "Primary Steel Producer" shall mean Steel Producer of any capacity, irrespective of process route, starting their operations from iron making using iron ore, virgin or processed, with necessary refining facilities and rolling/processing facilities, at a single location or else in multiple locations provided that the entire gamut of iron & steel production, from iron making to finished steel production, is owned by the same company or its subsidiary company(ies). Provided that the iron making capacity is sufficiently matching the steel making capacity. Further, downstream units should use material from the upstream units of the same company or its subsidiaries. In case of non-availability of certain steel section/s i.e. Angle smaller than 100x100x10 mm, MS flats, rounds, square bars and chequered plate from above acceptable primary steel producers, an option is given to the Main contractor to source these sections directly from SAIL Conversion/Wet Leasing agent subject to the conditions given at point no. A) below:			
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	A) Approval conditions for procurement of structural steel sections through SAIL Conversion/Wet Leasing agent: 1. Main Contractor to ensure continuity of BIS license of the manufacturer for the sections being manufactured for Employer supply. 2. Billets shall be procured from Employer approved Main Steel Producers. Proper records for traceability from raw material to final product shall be maintained. 3. 100% chemical analysis of the raw material (Billets) shall be carried out as per IS: 2830. Testing of one sample per 40 MT for each type of section or part thereof shall be carried out as per IS: 2062 on finished product. 4. Each lot of delivery of finished product shall be accompanied with co-relatable Manufacturer's Test Certificate (MTC). MTC of finished sections shall be correlated with original MTC for Billets received from Main Steel Producer and Manufacturer Test Report of chemical analysis of Billets mentioned at point no.3. MTC of finished sections shall include the reference of MTC for Billets from Main Steel Producer. 5. Employer will have access to carry out the surveillance checks for in-process stage. 6. In case of any defects are seen in the material, Main Contractor will replace the material without any cost implication to Employer. In case of non-availability of certain size/s of steel tubes conforming to IS:1161 and Hollow (square and rectangular) steel sections conforming to IS: 4923 from above acceptable primary steel producers, the same may be sourced from BIS approved sources having valid BIS license subject to the conditions given at point no. B) below: B) Approval conditions for procurement of Steel tubes conforming to IS: 1161 and Hollow (square and rectangular) steel sections conforming to IS: 4923 from BIS approved sources: 1. Main Contractor to ensure continuity of BIS license of the manufacturer for the sections being manufactured for Employer supply. 2. Raw materials shall be procured from Employer approved Main Steel Producers. 3. 100% chemical analysis of the raw material (steel) shall be carried out as per IS: 228. Testing of samples of steel tubes and hollow sections from each lot shall be carried out as per IS: 1161 & IS: 4923 respectively on finished product. 4. Each lot of delivery of finished product shall be accompanied with co-relatable Manufacturer's Test Certificate (MTC). 5. Employer will have access to carry out the surveillance checks for in-process stage. 6. In case of any defects are seen in the material, Main Contractor will replace the material without any cost implication to Employer. The specific methodology to be followed for above procurement through conversion route/BIS approved sources route shall be subject to approval by Employer in advance.			
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CLAUSE NO.	Quality Assurance for Civil Works				
5.0	CW/RW LINERS/PIPES				
	The following tests / checks shall be carried out for CW/RW Liner/Pipe works:				
	SL. No.	TESTS / CHECKS	QUANTUM / STANDARD		
	CW/RW Liners/pipes Fabricated at Site (Field Shop) and Factory Fabricated CW/RW Liners/Pipes using Steel Plates with Longitudinal & Circumferential Weld Joints				
	Option-1				
	1.	WPS, PQR & welder's Qualification	100%		
	2.	DPT on root run	100% for pipes up to 1200mm diameter		
	3.	DPT after back gouging	100% for pipes above 1200mm diameter		
	4.	UT	Not recommended.		
	5.	RT	5%		
	6.	DPT on finished butt welds	10%		
	7.	Hydro test	1.5 times the design pressure or 2 times the working pressure whichever is higher.		
	Option-2				
	1.	WPS, PQR& welder's Qualification	100%		
	2.	DPT on root run	100% for pipes up to 1200mm diameter		
	3.	DPT after back gouging	100% for pipes above 1200mm diameter		
	4.	UT	Not recommended		
	5.	RT	- 100 % RT on circumferential joints in the bottom 1/3 portion of CW liner for weld length as per Fig 1 - 5% RT on top 2/3 portion of circumferential joints and - 5% RT on longitudinal joints		
	6.	DPT on finished butt welds	10%		
	7.	Hydro test	No Hydro test		
	Factory fabricated CW/RW Liners/ pipes using H.R. coils with spiral weld joints				
	1.	WPS, PQR& welder's Qualification	100%		
	2.	DPT on root run	100% DPT for pipes up to 1200mm diameter		
3.	DPT after back gouging	100% DPT for pipes above 1200mm diameter			
4.	UT	Not recommended.			
5.	RT	5% RT			
6.	DPT on finished butt welds	10% DPT			
7.	Hydro test	Hydro test at 1.5 times the design pressure or 2 times the working pressure whichever is higher.			
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CLAUSE NO.	Quality Assurance for Civil Works				
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD		
	CW/RW Liners/Pipes erection site test				
	1.	WPS, PQR& welder's Qualification	100%		
	2.	DPT on root run	100% for pipes unto 1200mm diameter		
	3.	DPT after back gouging	100% for pipes above 1200mm diameter		
	4.	UT	Not recommended.		
	5.	RT	5%		
	6.	DPT on finished butt welds	10%		
	7.	Hydro test	1.5 times the design pressure or 2 times the working pressure whichever is higher. In exceptional cases where hydraulic test is not possible the same may be substituted with 100% RT in consultation with EIC.		
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CLAUSE NO.	 Quality Assurance for Civil Works 			
	ANNEXURE - I Format of Request Letter for Evaluation of Materials Ref: _____ Date: _____ To, Sub.: <u>Evaluation of materials and concrete mix design</u> 1. Evaluation of Cement: a) To carry out different physical tests on cement samples i.e. Blaine's fineness, initial and final setting time, soundness and compressive strength at 3, 7 and 28 days as per IS: 4031 Latest Edition and drying shrinkage and specific gravity in case of PPC. b) To carry out chemical analysis of the cement samples as per IS: 4032 Latest Edition, including the total alkali content of the cement (Na₂O equivalent) including HOH at approval stage. c) To advise the suitability of cement based on the test results of a) and b) above. 2. Evaluation of Aggregates: a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material content (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials), soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 383 Latest Edition & IS: 2386 Latest Edition. b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, soundness, deleterious material content (coal & lignite, clay lumps, material finer than 75-micron sieve, soft fragment, shale, Total of % of all deleterious materials), silt content, organic impurities and mica content as per IS: 383 Latest Edition & IS: 2386 Latest Edition. c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates to be used with the cement of 1) above. 3. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:			
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CLAUSE NO.	Quality Assurance for Civil Works												
	a) To carry out petrographic analysis and Alkali-Aggregate Reactivity as per IS 2386 (PART VIII & VII-Latest Edition) / ASTM C 227 (Standard Test Method for Potential Alkali Reactivity of Cement-aggregate Combination -Mortar Bar Method). b) If rock type is limestone, X-Ray diffraction test (XRD) shall be carried out to determine clay mineral in the rock for preliminary conclusions and to carry out repeated temperature cycle test to determine residual expansion of aggregate for concrete to be used in dynamic foundations like TG, Fans, mills, crushers etc. Additionally, Alkali carbonate reactivity test may be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis. c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used with the cement of 1) above and further testing required if any.												
4.	Evaluation of Fly ash Sample (if applicable) (As per IS-1489 Latest Edition) a) To carry out various physical and chemical tests on fly ash sample i.e. Blaine's fineness, lime reactivity, specific gravity, loss on ignition and other chemical tests as per IS: 3812, conforming to grade-I. b) To advise the suitability of fly ash sample based on the test results of a) above.												
5.	Evaluation of water: To carry out various physical and chemical tests as per IS: 456 Latest Edition and IS:3025 Latest Edition.												
6.	Evaluation of admixtures: To carry out various physical and chemical tests as per IS: 9103 Latest Edition. Note: Test certificate shall be obtained from the supplier to compare the values given in Table 2 of IS: 9103 Latest Edition i.e. uniformity tests and requirements.												
7.	Concrete Mix Design (As per IS-10262 Latest Edition): Based on the provisions of technical specification, the Following may be specified by site Construction department/Quality department ** a) For RCC Work i. Grade of concrete : ii. Slump required, mm : iii. Cement- Type and grade: : iv. Max Size of Aggregates, mm: : v. Exposure conditions : vi. Maximum water-cement ratio: : vii. Minimum cement content: : viii. Concrete admixture to be used or not (If yes, specify the brand/ type/batch no. of admixture) : ix. Fly ash to be used or not (If yes, indicate % of fly ash to be used): : b) For PCC work: Same as i) to ix) of a) above c) For piling work (if required): Same as i) to ix) of a) above												
8.	Details of material sampled: In order to facilitate the above- mentioned tests specified quantities of samples have been collected and sealed jointly (by Employer – Quality Control department, Execution department and contractors representative) is being sent for testing. The impression of seal has also been punched below. a) Quantity of material required for each mix-design: <table><tr><th>Sl. No.</th><th>Material Description</th><th>Quantity Required</th></tr><tr><td>i)</td><td>Cement</td><td>2 bags (sealed in double polythene bags)</td></tr><tr><td>ii)</td><td>Coarse Aggregates</td><td>100 Kg of each fraction as explained</td></tr></table>				Sl. No.	Material Description	Quantity Required	i)	Cement	2 bags (sealed in double polythene bags)	ii)	Coarse Aggregates	100 Kg of each fraction as explained
Sl. No.	Material Description	Quantity Required											
i)	Cement	2 bags (sealed in double polythene bags)											
ii)	Coarse Aggregates	100 Kg of each fraction as explained											
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		below: e.g.; If Maximum size of aggregates (MSA) is 20mm, then 100 Kg each of 20-10mm and 10mm down are required. If MSA is 40mm then 100Kg each of 40-20mm, 20-10mm and 10mm down are required.
iii)	Fine Aggregates	200Kg
iv)	Chemical Admixtures	2 Litres
v)	Water	10 Litres
vi)	Fly ash (If decided to be used)	100Kg

b) Quantity of material required for Alkali-Aggregate reactivity

Sl. No.	Material Description	Quantity Required
i)	<u>Coarse aggregate</u>	
ii)	<u>80-40mm</u>	60Kg
iii)	<u>40-20mm</u>	60Kg
iv)	<u>20-10mm</u>	60Kg
v)	<u><10mm</u>	60Kg
vi)	<u>Fine aggregates</u>	60Kg
vii)	<u>Cement</u>	2 samples (1 bag each), contemplated for use in construction.

Mark of seal:

You are requested to kindly forward us the test reports along with the recommendations regarding the suitability of materials to us at the earliest.

Thanking you,

Yours faithfully,

Name:

Designation:

Contact Number:

Email ID:

(Quality department Representative of Employer)

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	<u>Note:</u> <u>1. Based on provisions of technical specification, the testing charges for all the above-mentioned tests shall be borne by the contractor.</u> <u>2. The content of the letter is for guidance only, and if required may be suitably modified to suit the specific requirements of the package in consultation with Construction and quality department.</u> <u>3. ** This line may be deleted in the letter sent to the institute.</u>			
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INDICATIVE FIELD QUALITY PLAN											Annexure II
SUPPLIERS NAME AND ADDRESS		ITEM : Civil Work		QP NO. :		PROJECT:					
		SUB-SYSTEM : GEOTECH INVESTIGATION, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. :		PACKAGE:					
				DATE :		CONTRACT NO. :					
				PAGE :		MAIN CONTRACTOR :					
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
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1	GENERAL REQUIREMENTS										
A	Setting up of Field QA&QC laboratory, Availability of requisite laboratory set up and new equipment & duly calibrated well before commencement of concerned activity.		As agreed / required	B	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	Functioning & calibration status of laboratory equipment in proper working condition to be verified on monthly basis.	
B	Submission of QA & QC manpower deployment schedule and availability of manpower		As agreed / required	B	Physical	Manpower shall be deployed progressively as per the work front and discipline wise progress	Tech Specs and Const. Drawings		SR		
C	Sampling for testing of construction materials (Coarse aggregate, fine aggregate etc.), materials for concrete mix design etc.		As agreed / required	A	Physical	Once per each source	Tech Specs and Const. Drawings		SR/TR	Test report along with the recommendations from Employer acceptable laboratories to be submitted to EIC/FQA head for their review and acceptance.	
D	Submission of Monthly Test/QA reports/data		As agreed / required	A	Physical	Monthly	Tech Specs and Const. Drawings		SR/TR		
E	Stacking and storage of construction materials and components at site		As per IS:4082	B	Physical	Random in each week	Tech Specs and Const. Drawings, Manufacturer's guidelines and IS 4082		SR		
F	Survey										
	Construction of Bench Mark / Grid Pillars	To mark reference co-ordinate & elevation	As required / agreed	B	Physical	Each Bench Mark/ Grid Pillars	As per technical specifications/approved drawings		SR	Joint protocol for co-ordinate and elevation	
2	EXCAVATION, FILLING/BACKFILLING AND COMPACTION WORKS										
2.1	Excavations-										
i		Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random	Tech Specs and Const. Drawings		SR		
ii		Initial ground level before start of excavations, shape, Dimensions of excavations & Side slope of final excavation and Final excavation levels.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings		SR		
2.2	Excavation in Hard Rock- If required										
i		Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings		SR	Employer approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc.	
ii		Execution of Blasting Operation	As agreed / required	B	Physical	Random in each shift	IS:4081, Tech Specs and Const. Drawings/ scheme		SR		
iii		Submission of Blasting report to EIC	As agreed / required	B	Physical	Each blast	Tech Specs and Const. Drawings			Seismographs shall be deployed at site for monitoring of blast operation vibrations.	
iv		Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings		SR		
2.3	Filling/ Backfilling										
i	Suitability of fill material	Grain size analysis, Organic Matter, Liquid Limit, plastic limit, Shrinkage limit & Free Swell Index and chemical analysis(Like Organic Matter, Calcium carbonate, pH value, Total soluble sulphate etc.) as required in TS	As per IS: 2720	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.IV), IS:2720 Pt.XXII, IS:2720 (Pt.XI)/relevant part, Tech Specs and Const. Drawings		SR/TR	Test report along with the recommendations regarding suitability of the fill material from NTPC acceptable laboratories to be submitted to EIC for review and acceptance. Geo technical investigation report may also be considered as basis for suitability of fill material if available as per the discretion of EIC.	
2.4	Standard proctor Test	Optimum moisture content (OMC) and max. dry density (MDD) of filling/backfilling materials	As per IS: 2720	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings		SR/TR		
2.5	Compaction of Filling / Backfilling Works										
i	Moisture content	Moisture content of fill before compaction	As per IS: 2720	B	Physical	Random	IS 2720 (Pt.II), Tech Specs and Const. Drawings		SR/TR		
ii		Dry density by core cutter method ---- OR---- Dry density in place by sand	As per IS: 2720	A	Physical	i) For foundation back fill: one for every 10 foundations for each compacted layer.	IS 2720 (Pt. XXIX)/ IS 2720 (Pt. XXVIII)/		SR / TR		

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Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
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		replacement method ---- OR---- any other method as per IS2720				ii) For area filling: one every 1000 SQM area for each compacted layer.	IS 2720 Relevant Part/ Tech Specs and Const. Drawings				
iii		Relative density (Density Index)	As per IS: 2720	A	Physical	----do----- (I) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings		SR/TR	✓	
3	RAW MATERIALS FOR CONCRETE										
3.1	CEMENT										
i	Material	Physical and chemical properties as per relevant IS codes	As required/ agreed	A	Review of MTC/ test reports	for each manufacturing Week number	IS : 269/ IS:1489/ IS:455, Tech Specs and Const. Drawings		MTC	✓	To be procured from BIS approved source having valid BIS License. Each consignment of cement shall be duly correlated with manufacturers' TC.
ii		Testing of cement for Setting time (Initial & Final), Fineness, Soundness, and compressive strength	As per IS:4031	A	Physical	one for each manufacturing Week number	IS : 269/ IS:1489/ IS:455, Tech Specs and Const. Drawings		SR/Test Report	✓	Additionally, If the cement is stored more than 90 days in godown of contractor then the same shall be retested for Setting time.& Comp. Strength.
3.2	Coarse Aggregate										
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec		SR/LB	✓	During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, flakiness index, elongation index	IS:2386	B	Physical	One per 400 200 cum. or part thereof	IS: 2386 Part-I, IS:383 / Tech Spec		SR/LB/TR	✓	
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials),	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-V, IS:456, IS:383/Tech Spec		SR/LB/ TR	✓	During Design mix, these tests may be carried out.
iv		Alkali aggregate reactivity and Petrographic examination	IS 2386	A	Physical	-do-	IS: 2386 (Part-VII/VIII), IS:383 Spec/ASTM C-1260 / ASTM 1293	/Tech	SR/LB/ TR	✓	
v		Crushing value, Abrasion value and Impact value	IS:2386	A	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec		SR/LB/ TR	✓	
3.3	Fine Aggregate										
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec		SR/LB	✓	During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, Silt content	As agreed / required	B	Physical	One per 200 cum. or part thereof	Tech Spec/ IS 2386 / IS 456/ IS 383		SR/LB/ TR	✓	
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials (excluded mica as well as included mica content)), organic impurities	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-V, IS:456, IS:383/Tech Spec		SR/LB/ TR	✓	During Design mix, these tests may be carried out.
iv		Alkali aggregate reactivity and Petrographic examination	IS 2386	A	Physical	-do-	IS: 2386 (Part-VII/VIII), IS:383 Spec/ASTM C-1260 / ASTM 1293	/Tech	SR/LB/ TR	✓	
3.4	Water	Complete Testing as per IS:456-2000	As per IS:456	B	Testing	Once for each source and thereafter yearly in case of borewell. If water is used from open source like river, stream, canal etc., then water testing is to be done quarterly.	IS:456-2000/ Tech. spec.		TR	✓	

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3.5	Admixtures for Concrete	Material/Type of admixture and its suitability	As per IS:9103	A	Review of MTC/ test reports	For each lot received at site	As per Designed mix and IS:9103/ Tech. Spec.		Test Report/ MTC	√ suitability can be decided by trials with construction materials to be used for the indented application and depending on results obtained vis-a-vis the requirements, suitable construction chemical may be used.
4	CONCRETING (MIXING, CONVEYING, PLACEMENT, COMPACTION, CURING & TESTING)									
4.1	Batching Plant (if installed)									
i		Calibration of Batching Plant		A	Physical	To be calibrated at the time of starting and subsequently once in three months in house, and shall conform to IS:4925	Review of calibration chart/ Certificate/IS 4925		Calibration Certificate	√ Batching Plant shall be calibrated regularly at least once in a 3 months in-house. The weights for batching plant calibration to be calibrated once in year by NPL/NABL accredited lab./Weights & Measures Dept.
4.2	CONCRETE									
i		4 Trial mixes to ascertain the workability and cube strength	After receiving the recommended design	A	Physical	4 trial mix. for each mix proportion	Tech. Spec.IS 456/IS 10262		SR/LB	√ The concrete for field trials shall be produced by methods of actual concrete production.
ii		Concrete Cube strength Test	IS:516	A	Physical	One set of 6 cubes per 50 Cum or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, Tech. Spec.		SR/LB/ TR	√ Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days & remaining 3 shall be for 28 days Comp. Strength.
iii		Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site every two hrs.	IS:456/Tech. Spec.		SR/LB/ TR	√
iv		Temperature Control of Concrete as per Tech. spec./IS standard	Thermometer	B	Physical	100%	Temperature as per technical specification/Relevant standard		SR	√
v		Water Cement Ratio		B	Physical	For each batch of concrete	As per approved Design Mix		SR/Batch slip	√
vi		Placement of concrete, Compacting, Curing	As required	B	Physical	At Random	IS:456, Period of curing as per IS 456		SR	
4.3	TESTS / CHECKS ON RCC STRUCTURE IN HARDEDDED CONDITION									
i		Visual inspection of concrete surface just after removal of shuttering	As agreed / required	B	Visual	100%	As per IS:456/ tech. Specification.		SR	
ii		Dimensional check on finished structures	As agreed / required	B	Measurement	100%	As per IS:456/ tech. Specification and Const. Drawings		SR/LB	√
iii		Position and alignment of embedded parts and inserts	As agreed / required	B	Visual	100%	As per provisions and tolerances of equipment supplier, Tech Specs and Const. Drawings			
iv		Embedment of inserts in concrete shall be checked for gap if any using hammer for all dynamic foundations	As agreed / required	B	Physical	100%	As per Technical Specification		SR	√ No hollow sound
v		Submission of grouting / repair methodology to EIC for approval if concrete surface / position and alignment of embedded parts / inserts are found defective		B	Review and approval	once for each type of defect	As per provisions and tolerances, Tech Specs and Const. Drawings			√
vii		Core Test	IS:516	A	Physical	As required by Employer EIC.	As per IS:456, IS 516		SR/LB/ TR	√ Compressive strength based on core test is required to be carried out in case of doubt regarding the grade of concrete used, either due to poor workmanship or based on the results of cube strength test as per 3.5 ii) above and as per discretion of EIC.

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viii		Rebound Hammer test	IS:13311	A	physical	As required by Employer EIC.	As per relevant Standard/ tech. Specification.	SR/LB/ TR	√	This test may be carried out to assess the strength of concrete in case of non-critical and lightly loaded structures as per the discretions of EIC	
ix		Water Tightness Test of liquid retaining structure/ tanks	As required	A	Test	100%	IS:3370/ Tech. Specification	SR/LB	√		
5	REINFORCEMENT STEEL AND ITS PLACEMENT										
i	Material	Physical and chemical properties as per relevant IS codes and Tech spec.	As agreed/required	A	Review of MTC/ test reports	Each batch/lot of delivery	As per IS 1786, IS 432, IS 1566, tech spec and cont. drawing	MTC	√	To be procured from Employer approved source.	
ii		Freedom from cracks surface flaws, Lamination & excessive rust.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.	
iii		Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required	B	Physical & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	√		
iv		Acceptance - disposition of cage w.r.t. reference axes, cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	Measuring tape & as required	B	Visual & Measurement	Random in each shift*	IS 456, Tech Specs and Const. Drawings	SR	√	* 'for foundations, frequency shall be Each foundation	
6	FOUNDATION SYSTEM										
i		Foundation casting - Layout, Shape, dimensions, Reinforcement, concreting, curing etc.	As required / agreed	B	Physical	Each foundation	As per technical specifications and construction drawings	SR	√	lines and levels to be checked. Concrete Grade to be checked as per Mix Design	
7	STAGING AND FORMS										
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR			
ii		Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const. Drawings	SR			
iii		Acceptance of formwork before start of concreting : disposition w.r.t. reference axes, size, etc.	Measuring tape & as required	B	Physical / visual	Before start of each concreting	As per provisions and tolerances in IS 456, Tech Specs and Const. Drawings	SR	√		
9	EMBEDDED PARTS (INCLUDING LAYING OF RAILS & ANCHOR FASTENERS) --If Applicable.										
i		Material	As agreed / required	B	Review of MTC/ test reports	Each batch/lot of delivery	As per Tech Specs and Const. Drawings	SR/MTC	√		
i		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes/ etc. as per TS and construction Drg.	As agreed / required	B	Physical/ measurement	100%	As per Tech Specs and Const. Drawings	SR/ Protocol	√	Exposed surface of the embedded parts other than holding down bolts are to be painted with as per technical specifications.	
ii		Welding / tying of embedment to reinforcement	As agreed / required	B	Physical/ measurement	Random in each shift	As per Tech Specs and Const. Drawings	SR			
10	JOINTS IN CONCRETE, DAMP PROOF COURSE										
i	JOINTS IN CONCRETE	Joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophilic strip, Acrylic polymer etc. (as given in technical spec)	As per manufacturer Standards	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200	SR/MTC	√		

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ii	DAMP PROOF COURSE	Material - Hot bitumen and water proofing materials etc. (as given in technical spec).	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings, IS 702	SR/MTC	✓		
iii		Acceptance of installation of Joints material & Acceptance of damp proof course.	As agreed / required	B	Acceptance	Each installation randomly	Tech Specs and Const. Drawings		✓		
11	GROUTING										
i		Material	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR//MTC	✓		
ii		Compressive strength of grouting material before its use.	As agreed / required	A	Physical	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/LB/ TR	✓		
iii		Compressive strength of cubes after grouting.	As agreed / required	A	Physical	Random	Tech Specs and Const. Drawings	SR/LB/ TR	✓		
iv		Acceptance of the grouts : Mixing, placement, application and grout pressure (as applicable)	As agreed / required	B	Physical	Each grout section	Tech Specs and Const. Drawings	SR	✓		
12	MASONARY WORKS										
12.1	Test on Bricks										
i		Compressive strength, water absorption, efflorescence.	As agreed / required	A	Measurement / Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings	SR/LB/ TR	✓		
ii		Dimensions , shape, warpage.	As agreed / required	B	Measurement / Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings	SR/LB	✓	Warpage test is applicable for facing bricks only as per IS:2691.	
12.2	Modular aerated panel										
i	Material	As required	As agreed / required	A	Review of test report	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/LR	✓		
12.3	Autoclaved Aerated Concrete (AAC) block										
i		Material	As agreed / required	B	Review of MTC	Each batch/lot of delivery	Tech Specs /IS 2185 Part III and Const. Drawings	SR/MTC	✓		
ii		Compressive Strength and Density	As agreed / required	A	Physical	As per relevant IS Code/ One Sample for 10,000 nos. or part thereof	Tech Specs /IS 2185 Part III	TR	✓		
iii		Dimensions, shape	As agreed / required	B	Physical	As per relevant IS Code/ One	Tech Specs /IS 2185 Part III	TR/SR	✓		
12.4	Test on Mortar										
i	Sand	Grading	As agreed / required	B	Test	once per 400 200 Cum or part thereof	IS:2116	SR/LB	✓		
ii		Compressive strength	As agreed / required	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings	SR/TR	✓		
12.5	Masonry construction	Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905, Tech Specs and Const. Drawings	SR/LB			
13	PLASTERING- MATERIAL AND WORKMANSHIP										
i	Sand	Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I &II) & IS :2116, Tech Specs and	SR/TR	✓		
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	Tech Specs and Const. Drawings	SR/TR	✓		
iii		Silt content	As agreed / required	B	Physical	One per 100 cum., or part thereof	CPWD/ Tech Spec/ IS 2386/ IS 456/ IS 383	SR/LB/ TR	✓		
iv	Stone grit plaster/ granular textured coat finish (if applicable)	Material	As agreed / required	B	Review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	✓		
v	Galvanised wire mesh (if applicable)	Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	Review of MTC/ test reports	Each batch/lot of delivery at site	Tech Specs and Const. Drawings	SR/MTC	✓		
vi		Thickness, Trueness and finishing of plaster, grooves etc.	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR/LB	✓		
14	PAINTING SYSTEM - CONCRETE WORKS (including Chimney) AND PLASTERED MASONARY SURFACES										
i	Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc. as applicable (as given in technical spec).	Shade, type from brand and manufacturer as approved by EIC.	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		

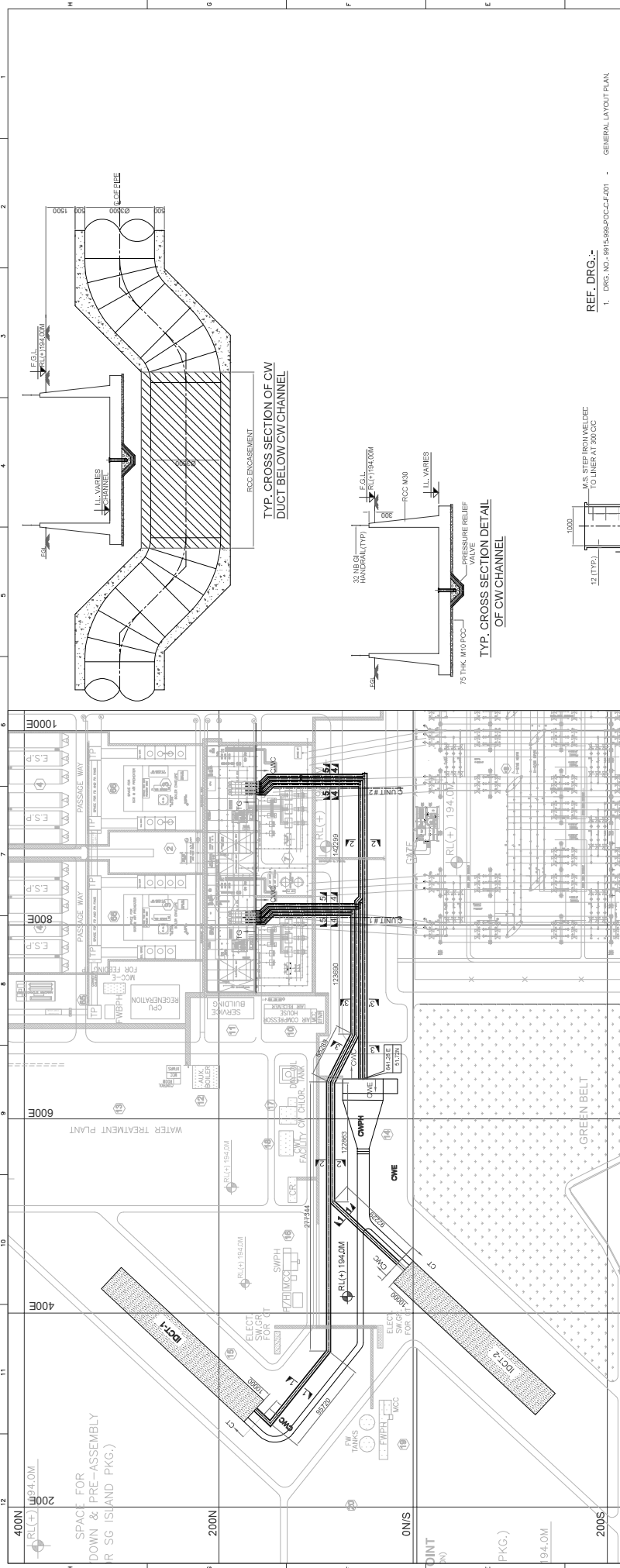
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ii	Surface preparation	As required	As agreed / required	B	Physical / visual	Random in each shift	Tech Specs and Const. Drawings		SR		
iii	Acceptance of painted surfaces	Shade, finish, WFT	As agreed / required	B	Physical/visual	Each surface at random	Tech Specs and Const. Drawings		SR	√	
14.2	PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)										
i		Painting Materials and accessories		A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii		Surface preparation	As agreed / required	B	Physical / visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards		SR	√	
iii		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
v		Acceptance of painted surfaces : DFT, Finish, Shade	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
15	SHEETING, INSULATION & ALLIED WORK										
i		Material : Profiled Colour coated Metal Deck & Cladding sheets	As agreed / required	A	Review of MTC / Test reports	Each lot received at site	Tech Specs and/ Const. Drawings/ profiled drawing		MTC/TR	√	Co-relation with MTC/TR (Video-jet printing or coil no. or any other means) may be verified with the lot received at site.
ii		Insulation material (other than Chimney insulation), galvanized wire net, aluminium foil, fasteners	As agreed / required	A	Review of MTC/ test reports	Each lot received at site	Tech Specs and/ Const. Drawings		SR / LB/MTC	√	All tests as per specification
iii		Insulation material (for Chimney insulation)	As agreed / required	A	Review of MTC/CHP/M DCC reports	Each lot received at site	Tech Specs and/ Const. Drawings		MTC/CHP/ MDCC/ Inspection report	√	
iv		Installation, lap alignment & workmanship.	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and/ Const. Drawings		SR		No gas cutting of colour coated sheets acceptable .
v		Finishing and acceptance	As agreed / required	B	Visual/ Physical	Each installation	Tech Specs and/ Const. Drawings		SR/LB	√	
16	DOORS , WINDOWS, VENTILATORS & GRILLS										
i	Steel doors	Materials & Check for shape tolerances thickness, welding & finishing of sections as per TS	As agreed / required	B	Visual/ Physical / test report	For each lot received at site	Tech Specs and Const. Drawings		SR / LB/TR	√	Review of test report
ii	Wood/Timber	Moisture content & anatomy	As agreed / required	A	Physical	For each lot received at site	Tech Specs and Const. Drawings/ IS 287		SR/LB	√	Tests to be carried out from Employer acceptable third party lab. like Forest Research Institute Dehradun. Frequency of check may be decided by EIC based on quantity and requirement.
iii	Wood work in frames	Check for dimensions, surface finish	As agreed/ required	B	Physical	Random for each installation	Tech Specs and Const. Drawings		SR	√	
iv	Flush Door shutter	End emersion test, knife test, adhesion test	As agreed/ required	A	Review of MTC/test reports	For each lot received at site	IS 2202, Tech Specs and Const. Drawings		SR/MTC	√	The required tests to be carried out from Employer acceptable third party lab. like Forest Research Institute Dehradun in addition to review of MTC/TR. Frequency of check may be decided by EIC based on quantity, requirement and IS 2202.
v	Particle Door		As agreed / required	A	Review of MTC/ test reports	For each lot received at site	IS:12823, Tech Specs and Const. Drawings		SR/MTC	√	The required tests to be carried out from Employer acceptable third party lab. like Forest Research Institute Dehradun in addition to review of MTC/TR. Frequency of check may be decided by EIC based on quantity, requirement and IS 12823.

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vi	Anodised aluminium works (Door & Window)	Materials- Aluminium sections, Coating	As agreed / required	A	Visual/ Physical / test report	For each lot received at site	IS: 1948, IS: 1949, IS:733, IS1285, IS:1868, IS:11857/ Tech Specs and Const. Drawings	SR / LB	√	Randomly one sample of each type may be send to Employer acceptable third party testing lab. for testing requirements as per TS and IS codes. Anodization shall be as per Tech. Spec. Frequency of check may be decided by EIC based on quantity, requirement and relevant IS code.	
vii	Fire proof doors	Material & Receipt inspection	As agreed / required	A	Review of MTC/ purchase order (unpriced copy) / drawings of suppliers / certificate of CBRI/CPRI/G OV. LAB. &	For each source & For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√	The door drawing proposed for supply should have been tested and approved by CBRI Roorkee/CPRI/GOV. LAB. for the similar dimensions for minimum fire rating as required in Tech. spec.	
viii	Rolling shutters	Surface finish and thickness of plate of approved make and DFT	As agreed / required	B	Physical / visual / review of MTC	Random for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
ix	Steel windows / Grills/ Louvre	Material fabrication and fixtures	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings	SR/MTC	√		
x	Doors / Windows Sections	Material - Rolled Steel, Z Sections,T-iron frames sections, Plates etc.	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
xi	Glass and glazing, Reflective toughened glass as per TS.	Material	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	IS: 14900, IS:1081, IS: 3548, IS:5437 Tech Specs and Const. Drawings	SR/MTC	√		
xii	Curved dome on roof/ Poly Carbonate Sheet	Materials - As per tech spec.	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Randomly one sample of each type may be send to Employer acceptable third party testing lab. for testing requirements as per TS and IS codes. Frequency of check may be decided by EIC based on quantity, requirement and Relevant IS code.	
xiii	False Ceiling	Materials - As per tech spec.	As agreed / required	A	Review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√	Randomly one sample of each type may be send to Employer acceptable third party testing lab. for testing requirements as per TS and IS codes. Frequency of check may be decided by EIC based on quantity, requirement and Relevant IS code.	
xiv		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR			
17	WATER PROOFING (Roof / Basement Treatment)										
i		Methodology for the application of water proofing system	As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings	SR	√		
ii	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings				
iii	Elastomeric coatings	Material- Primer coat, finishing coat	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications	
iv	Wearing course	Materials - As per tech spec.	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications	
v		Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings				
18	Fencing and Gates										

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i	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanized (IS 2629) etc.	Materials	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
ii	Structural steel, painting system, caster wheel, ball and bearing, fixtures and fasteners	Materials	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
iii		Alignments, erection painting, DFT etc. and acceptance of the installation and working	As agreed / required	B	Physical / measurement s	Each installation	Tech Specs and Const. Drawings		SR	√	
19	FLOOR FINISHES AND ALIED WORKS										
i	Cement Concrete Flooring	Glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings		SR		
ii	Ceramic tiles, vitrified tiles, glass mosaic, acid alkali resistant tiles, heavy duty cement concrete tiles (Materials as per TS)	Materials	As agreed / required	B	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications. In case non-availability of MTC, sample to be tested as per relevant IS code.
iii	Interlocking Blocks	Materials	As agreed / required	A	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
iv	Kota Stone, Granite and Marble	Materials: Quality, texture, thickness, colour for each lot of delivery	As agreed / required	B	Physical	Each lot of delivery	Tech Specs/ BOQ and Const. Drawings		SR/TR	√	
v	Metallic / non-metallic hardener	Material	As agreed / required	B	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/TR/MTC	√	
vii	Acid / alkali and oil resistant high built seamless epoxy based resin and treatment	Material	As agreed / required	A	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings		TR/MTC	√	work to be done by skilled manpower
		Surface preparation (as applicable)	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, IS 2395				
viii	Rubber Flooring	Material	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings / IS 809		TR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
ix		Finishing and acceptance of all above BOI	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
20	WATER SUPPLY / SANITORY INSTALLATIONS										
i	Material	Sanitary items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc, water supply / sanitation pipes (GI/ MS/ SCI/ CI / RCC), manhole cover and frames, Over head / loft type etc. as per TS	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/TR/MTC	√	
ii		leakage of pipes	As agreed / required	B	Physical	Each installation	Tech specs and const drawings		SR	√	
iii		Acceptance of installations of all sanitary items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings		SR		
20.2	RCC Pipes										
i	Material (As per TS)	RCC pipes	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/TR/MTC	√	To be procured from BIS Approved Sources having valid BIS License.
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR		
20.3	Water Storage Tanks										
i	Material (As per TS)	Over head / loft type	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings		SR/TR/MTC	√	To be procured from BIS Approved Sources having valid BIS License.
ii		Acceptance and leakage	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR		
21.0	SPECIAL ITEMS										
21.1	Earthing Mat (Grounding System)										

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i	Material (As per TS)	Earthing mat	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/TR/MTC	✓	
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings			Employer approved electrodes shall be used
iii		O P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	✓	
iv		Earth test	Earthing test kit	A	Physical	100%	Tech Specs and Const. Drawings,	SR/TR	✓	
21.2 Bitumen layer for tank foundation										
i	Material (As per TS)	Grade of bitumen	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	As per relevant IS and Tech. Specs /MTC	SR/MTC	✓	APPROVED SOURCE FOR MATERIAL PROCUREMENT SHALL BE ALL GOVERNMENT REFINARIES
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
21.3 Composite Aluminium Panels and structural glazing										
i	Material (As per TS)	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Technical specifications / drawings	SR/TR/MTC	✓	MTC shall cover all the properties / parameters as per technical specifications
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Technical specifications / drawings	SR		
21.4 Pressure Release Valves										
i	Material (As per TS)		As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Technical specifications / drawings	SR/TR/MTC	✓	
ii	Acceptance and workmanship	Acceptance / Installation workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR	✓	
21.5 ANTI WEED TREATMENT										
i	Material (As per TS)	Anti-weed treatment materials	As agreed / required	B	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/TR/MTC	✓	
ii		Execution of treatment	As agreed / required	B	Physical	Random check for each treatment	Tech Specs and Const. Drawings	SR		
23 PILING WORK (If Applicable)										
23.1 Execution										
i		Borehole diameter	As required	B	Physical	100%	As per appd. Drawings and technical specification	SR/LB	✓	
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓	
iii		Recording ground level and pile termination level	As required	B	Measurement	Random	As per appd. Drawings and technical specification	SR/LB	✓	
iv		Cleaning/Flushing of pile bore	As required	B	Measurement	Each pile	IS 2911/ Tech. Specs.	SR/LB	✓	
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.(if applicable)	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓	
vi		Pouring of concrete to project above cut off level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓	
23.2 Testing										
i		Bentonite	IS:2720	A	Physical / Test report	Once per lot	As per IS:2720, IS 2911/ tech. Specs.	SR/TR	✓	One sample from each source (brand/manufacturer) to be tested at Employer acceptable third party lab.

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Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks	
1	2	3		4	5	6	7	8	9	D*	10	
ii		Density check on sample of mud collected from pile bore bottom	IS 2911	B/A	Physical	Each pile/ Randomly 1 in 10 piles	IS:2911/ Tech. Specs./approved PILING METHODOLOGY	SR/LB	√		Tests to be done before placing of concrete.	
ii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√			
iii		Concrete Cube strength Test	IS:456	A	Physical	One set of 6 cubes per 50 Cum or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√			
iv		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pull-out (tension).	IS:2911 / as required	A	Testing	As per Technical Specification	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√			
v		Routine pile tests (VERTICAL LOAD TEST (COMPRESSION) and LATERAL LOAD TEST (horizontal))	IS:2911 / as required	A	Testing	As per Technical Specification	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√			
vi		Pile Integrity Tests (PIT)	PEM / as required	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers manual	Test Report	√			
22.0 GEOTECHNICAL INVESTIGATION WORK												
i		Deployment of Employer approved Geotechnical Investigation Agency Equipment, Manpower etc.	As required / agreed	B	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	√			
ii		Execution of Geotechnical Investigation - locations, type etc. as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications , approved drawing and relevant IS Codes	SR	√			
iii		Collection of disturbed and undisturbed samples , their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications , approved drawing and relevant IS Codes	SR				
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc. if applicable	As required / agreed	B	Physical	each field test	As per technical specifications , approved drawing and relevant IS Codes	SR	√			
v		Submission of Employer approved Final Geotechnical investigation report along with recommendations.	As required / agreed	B	Physical	After completion of investigation work	As per technical specifications and relevant IS Codes	-	√			
		LEGENDS : * Records identified with tick (√) shall be essentially included by supplier in QA documentation. # Class A : Critical, Class B : Major, Class C : Minor. Class 'A' checks shall be witnessed by Employer FQA and Execution Engineer, Class 'B' checks shall be witnessed by Employer Execution Engineer, Class 'C' checks shall be witnessed by Main contractor Site engineer. CLASS 'A' & 'B' CHECKS SHALL BE NTPC CHP STAGE. SR - Site Register, TR- Test Report, LB-Log Book, IR - Inspection Report, MTC - Manufacturer's Test Certificate.					For Employer Use		Employer DOC NO. :			
Main-supplier		Surveillance of Class 'A' checks shall be perform By Employer Head (FQA), Class 'B' by Employer FQA Engineer and for class 'C' Another Executing Engineer authorized by Head (Executing Deptt)							REVIEWED BY	APPROVE D BY	APPROVAL SEAL	



REF. DRG.:-

1. DRG. NO. - 9915-999-POC-C-F-001 - GENERAL LAYOUT PLAN

LEGEND:-

- CW EQUIPMENT PACKAGE.
CW CIVIL PACKAGE.
COOLING TOWER PACKAGE.
TG PACKAGE.
FINISHED GROUND LEVEL

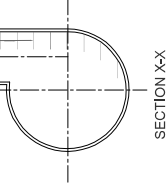
NOTES:-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. THE DRG. SHALL BE READ ALONG WITH DRG. NO.8/15/2009-PCC-401. TENDER DRG. NO.8/15/2009-PCC-401 SHALL BE TREATED AS TENDER DRG.
3. EDGE PREPARATION & JELDING OF LINER OF C/W DUCT AT THE TERMINAL POINTS ARE IN THE BIDDERS SCOPE.
4. THE LAYOUT SHOWN IN THIS DRAWING IS INDICATIVE.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATIONS BOQ AND OTHER TENDER DRAWINGS.
6. ALL CROSSINGS OF C/W CHANNEL AND C/W DUCTS ACROSS ROADS, DRAINS AND CANALS SHALL BE IN THE BIDDERS SCOPE.

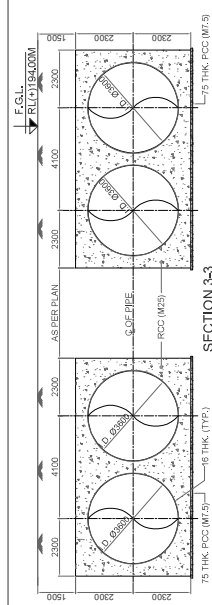
OWNER	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
CONSULTANT	NTPC LIMITED (A GOVT. OF INDIA ENTERPRISE) ENGINEERING DIVISION
PROJECT	KHURJA SUPER THERMAL POWER PROJECT 726660 MWs

FOR TENDER PURPOSE ONLY

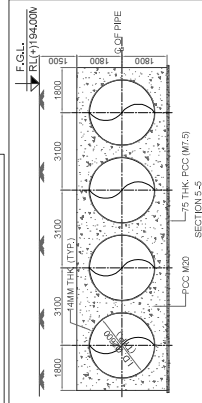
PROJECT		KHURJA SUPER THERMAL POWER PROJECT										ENGINEERING NUMBER	
SHEET NO.													
PROJECT		C-6850 MW											
TITLE		CW SYSTEM CIVIL WORKS PACKAGE											
		LAYOUT OF CW SYSTEM AND DETAIL OF CW CHANNEL & CW DUCT											
		DATE		REV.		BY		CHK		APPD		DATE	
		AT		SCALE		SHEET NO.		REV. NO.		N.T.A.		REQD. NO.	
		A		99/15/14-POC-A-002								A	



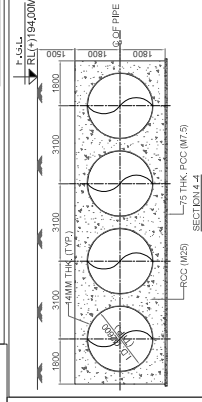
SECTION X-X



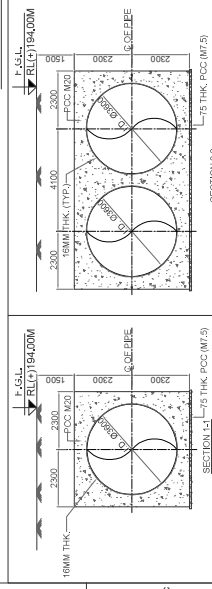
SECTION 3-3



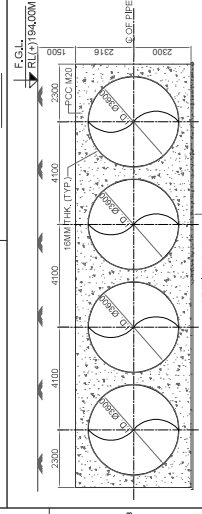
75 THK. PCC (M7.5)



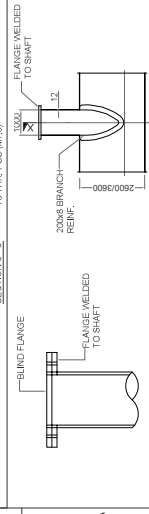
16 THK.
(M7.5)



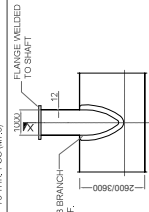
1.5)

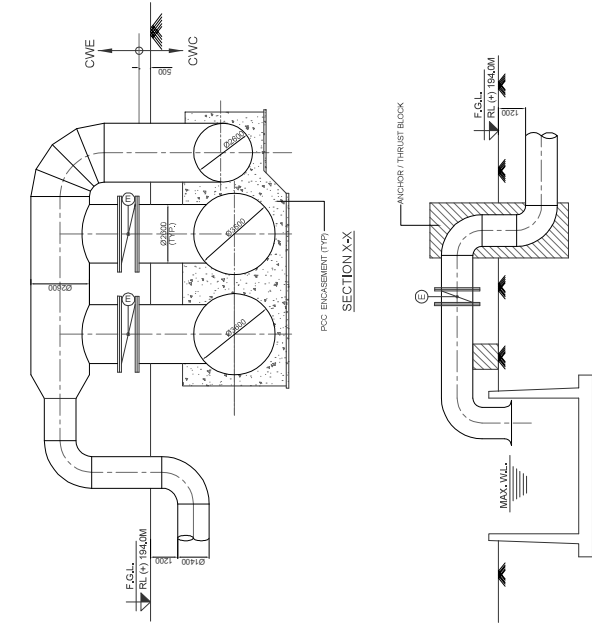


75 THK, P

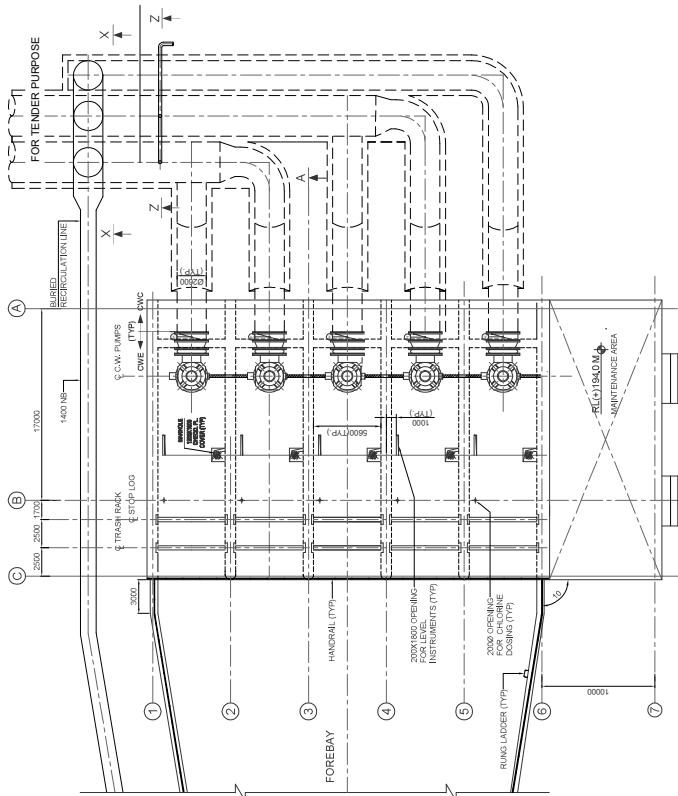


TYP. DETAIL OF BLIND FLANGE

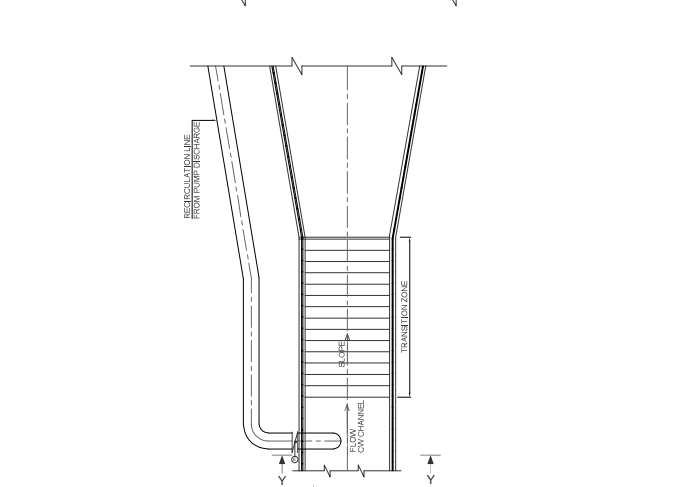




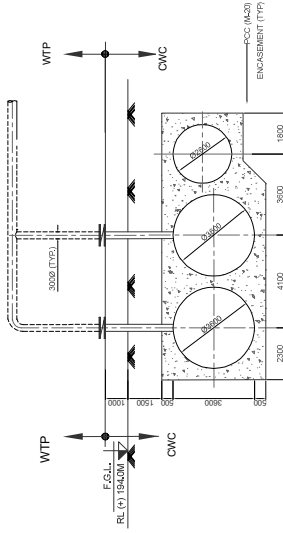
SECTION X-X



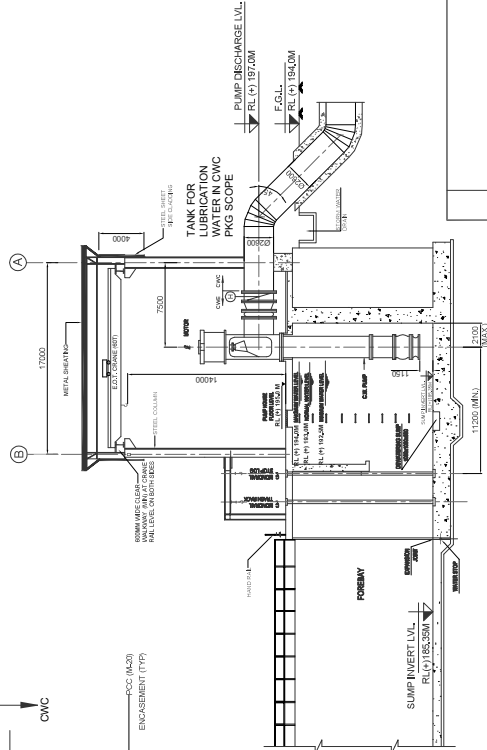
SECTION Y-Y



SECTION Z-Z



SECTION A-A



SECTION B-B

REF. DRG.:-

- 1. DRG. NO. 9815-414-POC-A-001 GENERAL LAYOUT PLAN
- 2. DRG. NO. 9815-414-POC-A-002 LAYOUT OF CW SYSTEM AND DETAIL OF CW CHANNEL & CW DUCT.

LEGEND :-

- 1. CWC : CW SYSTEM EQUIPMENT PACKAGE
- 2. CWC : CW SYSTEM AND CIVIL WORKS PACKAGE
- 3. WTP : WATER TREATMENT AND MISC. PKG

NOTES:-

- 1. ALL DIMENSIONS ARE IN MM AND ELEVATIONS ARE IN METRES.
- 2. F.S.L. CORRESPONDS TO RL (+) 194.0M.
- 3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRAWINGS AND SPECIFICATIONS.
- 4. ALL CIVIL WORKS SHALL BE CARRIED OUT IN THE PACKAGE. HOWEVER LAYING OF REGRADATION PIPE (INCLUDING EXCAVATION & BACKFILLING) SHALL BE IN CWC PACKAGE. REFER TECHNICAL SPECIFICATION FOR EXACT SCOPE OF WORK.
- 5. PACKAGE, SUPPLY & FIXING OF INSERT PLATE FOR THE ABOVE RAIL IN THE SCOPE OF THIS PACKAGE.

OWNER



THDC INDIA LIMITED
(A JV OF GOVT. OF INDIA & GOVT. OF UP)

CONSULTANT



NTPC LIMITED
(A GOVT. OF INDIA ENTERPRISE)

PROJECT

KHURJA SUPER THERMAL POWER PROJECT
(2x660 MW)

TITLE

CW SYSTEM CIVIL WORKS PACKAGE
GENERAL ARRANGEMENT OF CWC, PUMP HOUSE (WET PIT PUMPS)

REV. NO.	SCALE	DATE	BY	CHECKED	APPROVED	DESIGNED	DATE	BY	CHECKED	APPROVED	DESCRIPTION
A	1:1	28.12.21	CS	28.12.21	CS	28.12.21	CS	28.12.21	CS	28.12.21	FOR TENDER PURPOSE ONLY

FOR TENDER PURPOSE ONLY

CAD FILE NAME:

