Bhel Ranipet,Tamilnadu
Tender No: BAP:CP&S/ISRO/2022-23 Engineering,Procurement & Construction of Civil, Structural & Architectural Work of Aero Space Equipment Manufacturing Plant
Pre-bid Meeting – 09.06.22 Clarifications

Sl.No	Tender No	Clause no	Bidder Queries	Clarficiations
1	BAP:CP&S/ISRO/2022-23	GCC Cl.9	Request to confirm the notice period to inform Engineer-in-charge about Extension of time, Price variation or any other claims for deviation?	Request for extension of time should preferably be given minimum one month in advance before expiry of contract with proper delay analysis. Tender Conditions prevails for other quarries.
2	BAP:CP&S/ISRO/2022-23	SCC Cl.4	Request to confirm the compensation charges if the project execution is delayed by BHEL.	Tender conditions prevails
3	BAP:CP&S/ISRO/2022-23	SCC Cl.27	Prevailing market price of major materials like cement, reinforcement steel, structural steel are in high fluctuation. Request to confirm whether escalation shall be claimed as per variation in price indices using the standard formula for cost escalation mentioned in CPWD form of contract?	Price Variation Clause (PVC) for cement and steel shall be claimed.
4	BAP:CP&S/ISRO/2022-23	SCC Cl.5	Request to confirm the deviations attributed to client and not in deviation schedule can be compensated by BHEL	Tender conditions prevails
5	BAP:CP&S/ISRO/2022-23	GCC Cl.60	Ambiguity issues between conciliation scheme of BHEL and the clause mentioned in the tender document	Tender conditions prevails
6	BAP:CP&S/ISRO/2022-23	Chap 4 Cl.16	Request to reduce the Security deposit amount from 5% to 2%.	Security deposit as per technical specification to be complied.
7	BAP:CP&S/ISRO/2022-23	Specific Tech Req Cl.1.5	Request for any compensation applicable if there are any revisions in execution stage which leading to major damages and expenditure?	Tender conditions prevails
8	BAP:CP&S/ISRO/2022-23	SCC Cl.24	Request for 10% mobilisation advance on contract value.	Tender conditions prevails
9	BAP:CP&S/ISRO/2022-23	Nil	Request to confirm the order of precedence for the given tender.	Tender conditions prevails
10	BAP:CP&S/ISRO/2022-23	SCC Cl.16.2,16.3	Request BHEL to supply water and electricity at free of cost.	Tender conditions prevails
11	BAP:CP&S/ISRO/2022-23	GCC Cl.51	Request to confirm the method of proportion is applied for deviations or new items of work in considering nearest equivalent item of work in contract schedule or BHEL SOR?	Not applicable
12	BAP:CP&S/ISRO/2022-23	Special Instructions Cl.13	Request to confirm the billing method, whether on milestone basis or percentage of value of works done.	Tender conditions prevails

13	BAP:CP&S/ISRO/2022-23	Nil	Request to confirm whether we can have labour colony inside site area.	No. Space can be temporarily provided outside of plant premises for labour colony to accommodate authorised labour only.
14	BAP:CP&S/ISRO/2022-23	NIT	Request to confirm whether any extension of time shall be granted beyond 17 months.	Tender conditions prevails
15	BAP:CP&S/ISRO/2022-23	GCC Cl.41	Request to confirm whether any cost implication will be applicable due to delay in statutory authorities approvals.	Tender conditions prevails
16	BAP:CP&S/ISRO/2022-23	PQ requirement	Request to reduce the solvency certificate amount.	Bidders to comply and produce the certificate in support of the technical and financial competency
17	BAP:CP&S/ISRO/2022-23	Scope of contract Cl.8.2	Request BHEL to supply steel & cement on recovery basis because it involves huge initial investment.	Tender conditions prevails
18	BAP:CP&S/ISRO/2022-23	SCC Cl.17.1	Request to confirm whether sulphate resistance portland cement to be used in the foundation as per Geotechnical investigation report.	Tender conditions prevails
19	BAP:CP&S/ISRO/2022-23	Specific Tech Req Cl.17.8	Request to confirm whether normal pipe scaffolding can be used other than mechanised modular scaffolding as specified in tender.	State of the art technology to be adopted for the soundness, safety, reliability of the construction & to meet time schedule.
20	BAP:CP&S/ISRO/2022-23	Nil	Request to provide overall topo and contour survey drawings to assess the filling, site grading and other land development work.	Tender conditions prevails
21	BAP:CP&S/ISRO/2022-23	Scope of work Cl.3.0.02	Request to confirm duration required for approval of design and drawings.	BHEL will give observation/Comment on drgs as follows: Layout/GA drgs:15 days Design & other drgs: 7 days
22	BAP:CP&S/ISRO/2022-23	Specific Tech Req Cl.10	Request to confirm CBR value of soil to design road pavements.	Tender conditions prevails
23	BAP:CP&S/ISRO/2022-23	SCC Cl.1.2.1	Request to confirm whether we can use Expanded Polystyrene panel of 110 mm thick instead of masonry.	Tender conditions prevails
24	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to confirm Switch gear room dimension because there is variation in layout and brief scope of work.	5 metres height to be considered
25	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to confirm Office room dimension because there is variation in layout and brief scope of work.	Tender conditions prevails
26	BAP:CP&S/ISRO/2022-23	Specific Tech Req Cl.6.4.1	Request to confirm whether we can provide GSB and WMM under paving instead of soling stones rubble.	State of the art technology to be adopted for the soundness, reliability of the construction & to meet time schedule.
27	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to provide the dimensions for cable trench which are in scope of works for some of the buildings.	Tender conditions prevails
28	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to provide the detail for ETP, Acid Tank,machine foundation, Rack for Furnace, Raw Material Storage, or other equipment	Individual equipment foundation details will be furnished during contract stage. However, broad foundation details enclosed herewith.

			mentioned in the structure wise brief of works for Shop-3 & Shop-4.	
29	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to confirm whether Vitrified glazed or ceramic tiles to be used in loading bay.	Tender conditions prevails
30	BAP:CP&S/ISRO/2022-23	Site Layout	Request to provide the reduced level for internal road, existing road, existing invert level drainage.	Tender conditions prevails. Bidder to ensure as suit to the site conditions, prevailing practices and Govt. district norms.
31	BAP:CP&S/ISRO/2022-23	Nil	Request to confirm the maximum flood level at site.	As per Govt. District records
32	BAP:CP&S/ISRO/2022-23	Gen. Tech. Req. Cl.4a	Request to confirm whether we have to connect the internal storm water drain to external drainage system.	Yes
33	BAP:CP&S/ISRO/2022-23	Nil	Request to confirm whether any restrictions for vehicular movement for construction activities or access roads in site.	Tender conditions prevails in addition to prevailing safety and security regulations.
34	BAP:CP&S/ISRO/2022-23	Nil	Request to provide financial & technical bid evaluation methodology and weightage for each criteria.	Tender conditions prevails
35	BAP:CP&S/ISRO/2022-23	Structure Wise Brief Scope of works	Request to confirm the clear span required inside the building in between the columns.	Tender conditions prevails
36	BAP:CP&S/ISRO/2022-23	Spec. Design Req. Architectural Cl.2.06c	Request to confirm the open dimensions of rolling shutters and specifications like motorised, high speed, etc.	Tender conditions prevails
37	BAP:CP&S/ISRO/2022-23	Spec. Design Req. Architectural Cl.2.06c	Request to confirm the major hanging loads, collateral loads, special equipment loads, and other needs to be considered.	Tender conditions prevails
38		CHAPTER-IV - 1	CE VARIATION. We kindly request you to provide price variation clause.	Tender conditions prevails
39		17.1.4	Please arrange to confirm the following brands in the ved vendor list in addition to the existing vendors. Chettinad, Zurai, India Cements	Other than cement brands specified in tender Conditions, bidder can procure cement from India Cements, Chettinad, RAMCO, TANCEM, BIRLA also. Cement from others suppliers can be done with prior approval of BHEL.
40		172	Kindly prpvide list Of makes for Reinforcement steel and Structural steel.	Other than steel brands specified in tender Conditions, bidder can procure steel from JSPL, SAIL, Noval Tech also. Steel from others prominent suppliers can be done with prior approval of BHEL.
41		22	The time frame Of 17 months for completion is not feasible as per the project requirements and therefore it should be increased to atleast 24 months	Tender conditions prevails

42		File 02.00: scope of work- 3-02.05	Statutory requirements: Please specify what are the statutory requirements and clearances.	Consent for the construction and consent to operate shall be provided by BHEL from State authorities. All others to be taken care by the bidder
43		File 03.00: Specific Technicál Requirement Civil Works	Please confirm whether We have to submit designs and drawings along with tender.	No
44		Bid Due Date	We like to participate in the above subjected tender. We have gone through the document thoroughly. And it was found that, there are many items to work upon. So it might take some more time to prepare the tender. So i humbly request you to extend the tender submission date by one month.	Considering the clarifications sought in the prebid meeting on 09.06.22 and discussions time, tender submission date extended for two weeks till 06.07.22
45			Clean room/EOT/Fire fighting/F.A.S/Lights/AC - Excluded	Tender conditions prevails
46			Plant & machineries shall be deployed as per requirements	Tender conditions prevails
47			Price escalation not applicable	Tender conditions prevails
48			Acid & alkalic lining – Height 1.2 Mtr	Tender conditions prevails
49			Shop 4 full structure epoxy paint	Shop-4: Entire structural steel of shed and inner face of Cladding/roof sheet shall be provided with acid & alkali resistant coating.
50			Is only shop 4 is epoxy paint (or) all sheet to be epoxy paint	
51			Masonry cladding for full height of 15 mtr. (Shop 1 & 2 – Panel walls)	Tender conditions prevails
52			Ancillary building height 7 mtr (Masonry wall)	Tender conditions prevails
53			Machine foundation details	As per reply to point no. 28
54			Glass partition between shop 1 & 2 (Scope)	Tender conditions prevails
55			Internal partition inside shop floors	Tender conditions prevails
56			Shop 1 & 2 – A type of flat roof with sheet	Tender conditions prevails
57			EOT – Walkway – Scope	Tender conditions prevails
58			Rain wall is considered as 60mm (Shall we consider in 100/150 mm)	Tender conditions prevails
59			Compound wall is chain link fencing to confirm	Tender conditions prevails
60			Roads are concrete with paver	No. It is bituminous road. Bidder to follow road width given in plant layout.
61			N.D.T & X ray room detailed requirement	As per relevant BIS standards
62			E.O.T bay / Shop 1,2,3, & 4 Bay as per requirement	Tender conditions prevails
63			Material Basic cost (Cement, Steel, Structural Steel, RCC)	Tender conditions prevails
64			Cat walk way for EOT access - Regular maintenance & operations?	Tender conditions prevails

Apart the above, clarifications sought by the bidders during the meeting

1. Statutory clearance for state authorities for construction of the plant and consent to operate to be obtained before the award of work.

   Consensus from concerned will be taken up by BHEL

2. Payment for Steel and Cement shall be made once material is received at BHEL

   Agreed. 80% Payment will be made against material receipt certificate (MRC). Each consignment shall be delivered in minimum 2 months

Equipment details		
Sl. No.	**Item name & broad specification**	**Foundation requirement**
A	**Machining facility**	
1	CNC 4 axis Vertical Turn Mill centre 1. No. of axis: 4 (X, Y, Z & C) 2. Tabe Dia: 3000mm	Around 2 metres
2	CNC 4 axis Vertical Turn Mill centre 1. No. of axis: 4 (X, Y, Z & C) 2. Tabe Dia: 4000mm 3. Turning Dia: 5000mm	Around 2 metres
B	**Chemical Milling & processing facility**	
1	Masking facility	Around 300mm
2	Chemical Milling Line (Vapour Degreasing, Alkaline, Cold Water, Maskat, Chemical Milling, Cold Water, Deoxidiser & Hot Water Bath)	Around 300mm
3	Anodisation bath Chromic acid & associated baths	Around 300mm
4	Anodisation bath Sulphuric acid & associated baths	Around 300mm
5	DM water tank (capacity: >40000 Ltr.) and plant (capacity: >2500 Ltr./hour)	Around 300mm
6	ETP: To regulate discharge from above facilities as per norms specified by Statutory bodies.	Around 2 metres
C	**Heat treatment facility**	
1	Solutionising - Drop bottom furnace 1. Working chamber size: 4.2M x 1.4M x 2.3M 2. Type: Electrical heating 3. Operating temp: 100-600 ^{o}C 4. Class II furnace with +/-5 ^{o}C 5. Type of loading: vertical 6. Max. time to quench: 10 sec	Around 300mm
2	Annealing/Ageing furnace 1. Working chamber size: 4.5Mx1.5Mx2.75M 2. Type: Electrical heating 3.Max. oven temp: 200^{o}C 4. Class II furnace with +/-5 ^{o}C	Around 300mm

5	Sub Zero treatment furnace 1. Working chamber size: 0.5M x 1M x 0.5M 2. Temp range: -70 ^{o}C +/-1 ^{o}C 3. Load capacity : 100 Kg.	Around 300mm
6	Cold storage - Deep freezer for baffles 1. Working chamber size: 2M x 2M x 2M 2. Temp range: -10 ^{o}C +/-1 ^{o}C 3. Load capacity: 500 Kg.	Around 300mm
D	**Press / Sheet Strech Forming facility**	
1	Sheet Stretch forming Press 1. Material to be processed: Aluminium alloy Sheet 2. Max. load capacity: 1500 T 3. Max. sheet size: 4M x 2.3M	Around 2 metres
2	03 Roll Plate Bending machine 1. Bending material: Aluminium sheet 2. Bending capacity: 15 mm x 3000 mm	Around 2 metres
E	**Welding facility**	
1	Heavy duty Friction Stir Welding (FSW) for linear & cylindrical welding 1. Linear welding of Cylindrical shell. 2. Dome to ring and Ring to Circular shell Cir-seam welding. 3. Petal to petal meridian welding of aluminium alloys sheet for Dome.	Around 2 metres
2	TIG welding with Column & boom manipulator and without milling head	Around 300mm
F	**Material Handling** Note: Span of EOT cranes may have slight variation based on civil drawing approval	
1	EOT Crane Capacity: 10T Span: 33.5M	Not applicable
2	EOT Crane Capacity: 10T ; Span: 19M	Not applicable
3	EOT Crane Capacity: 10T; Span: 23M	Not applicable
4	EOT Crane Capacity: 10T; Span: 14M	Not applicable
5	EOT Crane Capacity: 5T; Span: 23.5M	Not applicable
6	EOT Crane Capacity: 5T; Span: 14M	Not applicable
7	EOT Crane Capacity: 5T; Span: 10M	Not applicable
G	Module type Painting facility with exhaust system Chamber size: 6M x 12M x 8M	Around 300mm
I	**Inspection & NDT equipments**	
1	Computerized Universal Hardness Tester 1. Type of force application: Electronic 2. Testing standard: ISO/ASTM	Floor mounted
2	3D CNC Co-ordinate Measuring M/c. 1. Range of measurement: 5 M x 5M x 3M 2. Gantry/Bridge type	Floor mounted
3	Ultrasonic Thickness Gauge 1. Priniciple of operation: Pulse echo	Floor mounted

4	Phased Array Ultrasonic Thickness Detector 1. Type of display : LCD 2. No. of total elements : 128	Floor mounted
5	X-Ray machine 1. Xray tube: Dual focus (160kVA) 2. Power supply: 230V (±15%)	Floor mounted
6	Radiographic Film viewer 1. Density upto 4.7 D 2. Input power: 230V	Floor mounted
7	Auto film processor 1. Mode: automatic 2. Input voltage: 220 V (±10%)	Floor mounted
8	Film Densitometer 1. Display: Digital 2. Power supply: 230V and/or battery mode	Floor mounted
9	Laser Tracker Instrument 1. Machine type: Portable type	
10	Laser Engraver 1. Type of Laser: Fiber 2. Power supply: 220V-240V	Floor mounted
11	Mass Spectrometer Leak Detector (MSLD) 1. Tracer gas: Helium 2. Voltage: 240V AC, 50Hz	Floor mounted
12	Leak test console 1. Medium used: Gaseous Helium with MSLD equipment	Floor mounted
13	Video Scope 1. Light source: LED	Floor mounted
14	Pressure test facility with strain gauge 1. Single or double element strain gauge	Floor mounted
15	Accoustic Emmission Monitoring 1. No. of AE data channels : 96 2. Resonance: @150 KHz	Floor mounted
16	Ferritoscope 1. Measuring range: 0.15-80 % FE	Floor mounted
17	Conductivity Measuring Instrument 1. Type of probe: Eddy current probe	Floor mounted
18	Eddy Current Flaw Detector 1. Frequency range - 10 Hz to 10 MHz 2. Power requirement - 230 V, 50 Hz.	Floor mounted
19	Viscosity Measuring Instrument 1. Accuracy : +/- 1 %	Floor mounted
20	Air Particle Counter 1. Particle counter nominal flow rate: 1 CFM	Floor mounted
21	Dew Point Moister Analyser 1. Range : -100 degC to +20 degC dew point 2. Accuracy: +/- 2 degC	Floor mounted

22	Humidity Measuring Instrument 1. Measuring Range : 0 to 100%RH 2. Display: LCD	Floor mounted
23	Universal Testing Machine 1. Max force capacity : 250 KN 2. Test mode: Tension & Compression	Floor mounted
K	**Power Distribution** - 11kV Transmission line form Sipcot to BHEL (higher capacity conductor) - 5 MVA, 11KV AVR Transformer -1250kVA, 11kV/415 V Distribution Transformer (02 Nos.) -2000kVA, 11kV/415 V Distribution Transformer (01 No.) -Air Circuit Breakers, Capacitor Bank, Cables -1000kVA, 11kV Diesel Generator Set (01No.) -Power Distribution in Shops	As per standards

1.0 PRICE VARIATION COMPENSATION (PVC)

1.01
In order to take care of variation in cost of execution of work on either side, due to variation in the index of CEMENT & STEEL Price Variation Formula as described herein shall be applicable (only for works executed during extended period, if any, subject to other conditions as described in this section).

1.02
30% component of executed Contract Value shall be considered for PVC calculations and remaining 70% shall be treated as fixed component. The basis for calculation of price variation in each category, their component, Base Index, shall be as under:

S. No	Category	Base Index	Percentage Component ('K')
1	Cement	Name of Commodity : ORDINARY PORTLAND CEMENT Commodity code 1309030001 ***	5
2	STEEL Structural and Reinforcement Steel	Name of Commodity : a2. STEEL LONG Commodity code 1310010200 ***	25

*** As per the 'MONTHLY WHOLE SALE PRICE INDEX' for the respective Commodity and Type, published by Office of Economic Adviser, Ministry of Commerce and Industry, Government of India.(Website: http://www.eaindustry.nic.in/download data 0405.asp). Revisions in the index or commodity will be re adjusted accordingly.

1.03
Payment/recovery due to variation in index shall be determined on the basis of the following national formala in respect of the identified component ('K') viz. CEMENT, STEEL MATERIALS

$$P = K \times R \times \frac{(X_N - Xo)}{Xo}$$

where

P = Amount to be paid/recovered due to variation in the Index for Cement and Steel materials

K = Percentage component ('K') applicable for Cement and Steel materials

R = Value of work done for the billing month (Excluding Taxes and Duties if payable extra)

X_N = Revised Index for Cement and Steel materials

Xo = Index for Cement and Steel materials

1.04
Base date shall be the calendar month of the schedule completion date (i.e. Actual Start date + Scheduled Contractual Completion period as per Letter of Intent/award and/or work order).

1.05
PVC shall not be payable for the ORC amount, Supplementary /Additional items, Extra works. However, PVC will be payable for items executed under quantity variation of BOQ items under originally awarded contract.

1.06
The contract shall furnish necessary monthly bulletins in support of the requisite indices from the relevant websites along with his Bills

1.07
The contractor will be required to raise the bills for price variation payments on a monthly quarterly basis along with the running bills irrespective of the fact whether any increase/decrease in the index for relevant categories has taken place or not. In case there is delay in publication of bulletins (final figure), the provisional values as published can be considered for payments and arrears shall be paid/recovered on getting the final values.

1.08
PVC shall be applicable only, during extended period of contract (if any) after the scheduled completion period and for the portion of work delayed/backlog for the reasons not attributable to the contractor.

However, the total Quantum of Price Variation Amount payable/recoverable shall be regulated as follows,

i) For the portion of shortfall/backlog not attributable to the contractor, PVC shall be worked out on the basis of indices applicable for the respective month in which work is done. Base index shall be applicable as per clause no. 1.04

ii) In case of Force Majeure, the PVC shall be regulated as para (a) or (b) below)

a) Force Majeure is invoked before "Base Date"/"revised base date" (as explained below) OR immediately after "base date/"revised base date" in continuation (i.e. during the period when PVC is not applicable)

1. Base date shall be revised: Revised Base date + duration of Force Majeure.

   No PVC will be applicable for the work done till revised base date

2. PVC will be applicable for the work done after "base date"/"revised date" as the case may be (during extended period when delay is not attributable to contractor). PVC shall be worked out on the basis of indices applicable for the respective month in which work is done with base index as on the "base date"/"revised base date" as the case may be

b) Force Majeure is invoked after "base date"/"revised base date" as the case may be (during extended period when delay is not attributable to contractor).

1. PVC shall be applicable for the work done after revocation of Force Majeure.

2. PVC for the work done after revocation of Force Majeure shall be worked out on the basis of indices applicable for the respective month on which work is done excluding the effect of change in indices during total period of Force Majeure(s) invoked after "base date" / "revised base date" as the case may be

iii) The total amount of PVC shall not exceed 15% of the cumulatively executed contract value. Executed Contract value for this purpose is exclusive of PVC,

ORC, Supplementary/Additional items and Extra works except items due to quantity variation.

Engineering, Procurement & Construction (EPC) of Civil, Structural & Architectural Work of Aero Space Equipment Manufacturing Plant Civil Package

Tender Document No – BAP:CP&S/ISRO/2022-23

File 04.40 - Specific Technical & Design Requirement
Pre Engineering Building (PEB)

BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)
Boiler Auxiliaries Plant
Indira Gandhi Industrial Complex,
Ranipet-632406, (Tamil Nadu), India.

INDEX

TECHNICAL SPECIFICATIONS AND SCOPE OF WORK

GENERAL: The technical specifications and scope of work for Pre-Engineered Building (PEB) System is defined in the following sections under the contract which includes design, manufacture, supply and erection of Structural Steel System, Metal Roof System, Wall System, Trims and Flashings, Turbo Ventilators and all accessories as required for the successful and satisfactory completion of the contract

SECTION –A: BUILDING DESCRIPTION

The brief building description for various areas of Proposed Project are as below: All frames shall be designed for future expansion.

1. Fabrication Bay (Shop No.-3)

a. Span : 25 m inner to inner
b. Length : 90 m c/c column
c. Clear height : 9 m (Bottom of EOT crane)
d. Crane (EOT) Span : Approx 24.0m Rail to Rail distance.
e. Roof Slope : 1:10
f. Bay spacing : approx. 7.5 m c/c.
g. No expansion joint is to be provided instead two no. of Longitudinal portal bracing to be provided at a spacing of 50m as specified in IS-800-2007
h. Roof: 0.5mm TCT Standing seam profile Bare galvalume sheets for the Roof Single skin.
i. Wall cladding: 0.5mm TCT Color coated Galvalume sheet for the walls above 3.6m brick wall Single skin (Trapezoidal profile).
j. Canopy for the full length of the building on both sides and other sides partial.
k. Framed openings : Will be finalized during engineering stage.
l. Canopies for openings : Minimum 1.5m Projection with end closing and curved eaves,
m. EOT Crane : 10 MT - 1 No.
n. Crane Rail supply and fixing : By BHEL
o. Opal white-2mm Poly carbonate sheets for sky lights : 5% of Roof Plan Area.
p. Sliding door as per requirement. (one side covered with color coated galvalume same as wall sheet).
q. Roof Monitor : 1.8m x 1.5m with crimped trapezoidal bare galvalume sheets and poly carbonate profiled Sheets on both the vertical sides.
r. Eaves Gutter & Down take pipes : in Color galvalume sheets.
s. Turbine ventilators 2 Nos per bay. Zig zag arrangement on overall length.

2. Fabrication Bay (Shop No.-4)

a. Span : 25 m Inner to inner.
b. Length : 100 m c/c of column.
c. Clear height : 9 m (Bottom of EOT crane).
d. Crane (EOT) Span : Approx 24.0 Rail to Rail distance.
e. Roof Slope : 1:10
f. Bay spacing : approx. 7.5 m c/c.
g. No expansion joint is to be provided instead two no. of Longitudinal portal bracing to be provided at a spacing of 50m as specified in IS-800-2007

h. Roof: 0.5mm TCT Standing seam profile Bare galvalume sheets for the Roof Single skin.
i. Wall cladding: 0.5mm TCT Color coated Galvalume sheet for the walls above 3.6m brick wall Single skin (Trapezoidal profile).
j. Canopy for the full length of the building on both sides and other sides partial.
k. Framed openings : Will be finalized during engineering stage.
l. Canopies for openings : Minimum 1.5m Projection with end closing and curved eaves,
m. EOT Crane : 10 MT - 1 No.
n. Crane Rail supply and fixing : By BHEL
o. Opal white-2mm Poly carbonate sheets for sky lights : 5% of Roof Plan Area.
p. Sliding door as per requirement. (one side covered with color coated galvalume same as wall sheet).
q. Roof Monitor : 1.8m x 1.5m with crimped trapezoidal bare galvalume sheets and poly carbonate profiled Sheets on both the vertical sides.
r. Eaves Gutter & Down take pipes : in Color galvalume sheets.
s. Turbine ventilators 2 Nos per bay. Zig zag arrangement on overall length.

3. Tool Shop.

a. Span : 15 m Inner to inner.
b. Length : 51 m c/c of column.
c. Clear height : 9 m (Bottom of EOT crane).
d. Crane (EOT) Span : Approx 14.0 Rail to Rail distance.
e. Roof Slope : 1:10
f. Bay spacing : approx. 7.5 m c/c.
g. No expansion joint is to be provided instead two no. of Longitudinal portal bracing to be provided at a spacing of 50m as specified in IS-800-2007
h. Roof: 0.5mm TCT Standing seam profile Bare galvalume sheets for the Roof Single skin.
i. Wall cladding: 0.5mm TCT Color coated Galvalume sheet for the walls above 3.6m brick wall Single skin (Trapezoidal profile).
j. Canopy for the full length of the building on both sides and other sides partial. (If Required)
k. Framed openings : Will be finalized during engineering stage.
l. Canopies for openings : Minimum 1.5m Projection with end closing and curved eaves,
m. EOT Crane : 10 MT - 1 No.
n. Crane Rail supply and fixing : By BHEL
o. Opal white-2mm Poly carbonate sheets for sky lights : 5% of Roof Plan Area.
p. Sliding door as per requirement. (one side covered with color coated galvalume same as wall sheet).
q. Roof Monitor : 1.8m x 1.5m with crimped trapezoidal bare galvalume sheets and poly carbonate profiled Sheets on both the vertical sides.
r. Eaves Gutter & Down take pipes : in Color galvalume sheets.
s. Turbine ventilators 2 Nos per bay. Zig zag arrangement on overall length.

4. Loading Bay.

a. Span : 13 m Inner to inner.
b. Length : 20 m c/c of column.
c. Clear height : 9 m (Bottom of EOT crane).
d. Crane (EOT) Span : Approx 12.0 Rail to Rail distance.
e. Roof Slope : 1:10

f. Bay spacing : approx. 7.5 m c/c.
g. No expansion joint is to be provided instead two no. of Longitudinal portal bracing to be provided at a spacing of 50m as specified in IS-800-2007
h. Roof: 0.5mm TCT Standing seam profile Bare galvalume sheets for the Roof Single skin.
i. Wall cladding: 0.5mm TCT Color coated Galvalume sheet for the walls above 3.6m brick wall Single skin (Trapezoidal profile).
j. Canopy for the full length of the building on both sides and other sides partial. (If Required)
k. Framed openings : Will be finalized during engineering stage.
l. Canopies for openings : Minimum 1.5m Projection with end closing and curved eaves,
m. EOT Crane : 10 MT - 1 No.
n. Crane Rail supply and fixing : By BHEL
o. Opal white-2mm Poly carbonate sheets for sky lights : 5% of Roof Plan Area.
p. Sliding door as per requirement. (one side covered with color coated galvalume same as wall sheet).
q. Roof Monitor : 1.8m x 1.5m with crimped trapezoidal bare galvalume sheets and poly carbonate profiled Sheets on both the vertical sides.
r. Eaves Gutter & Down take pipes : in Color galvalume sheets.
s. Turbine ventilators 2 Nos per bay. Zig zag arrangement on overall length.

SECTION –B: BUILDING COMPONENTS

Various components of the buildings are:

1. Metal roof sheets,
2. Side sheeting, Purlins, sag rods cleats, bolts and nuts,
3. Roof Ventilators (Turbine) 20 nos.
4. Translucent sheets for light (Poly carbonate),
5. Purlins,
6. eaves strut
7. Steel Portal Frames including Crane leg /stepped column,
8. Rafter bracings with rod and pipe
9. Column bracings, Portal Bracings at 1 place,
10. Gable end sheeting, purlin, columns,
11. Trims and Flashings
12. Gutters, calculation to be shown to justify the size,
13. Down take pipes, calculation to be shown to justify the size,
14. Crane girders EOT, legs connections, bolts to roof Leg and Crane leg,
15. Buffer stop (Design Refer Annexure)
16. Stair case to approach crane 1 no./ building at gable end.
17. Crane walk way and Hand Rails on both sides with toe plate and 5mm tk.
18. Chequred plates, on both sides of the bay as well as on the gable side.
19. Sliding doors – 2 Nos.
20. Canopy for full length of the building with end closed.
21. Connecting bolts (high strength),
22. Framed openings for sliding door
23. Canopy for sliding door openings with ends closed.
24. Base plates with Gussets for stiffening as per design.
25. Shim plates for column erection

26. Roof monitor for the entire length of the building with curved sheets for roof and vertical POLY CARBONATE sheets as per drawing.
27. Flashings & trims.
28. Foundation bolts.

SECTION –C: DESIGN AND DRAWINGS

1. GENERAL:

a. Design of foundation and all members including primary & secondary members shall be in the scope of the tenderer and release of the fabrication / erection drawings will be done after design vetting from IIT / IISC & verification by BHEL. The design considerations given hereunder establish the minimum basic requirements for the design. However, structure shall be designed for the satisfactory performance of the functions for which the same is to be constructed.

b. Design should be based on Limit State method.

2. LOADING:

a. The structure shall be designed for all loads, including the weight of structure, live load, wind or earthquake. Due consideration shall be given to loading during the construction/erection phase and accounted for in the design. The design to be cater for the proposed future expansion also.

b. **Dead Load:** Self Weight of Structure including Purlins, Sheeting, Girts Bracings weight of turbo ventilators to be added as Dead load.

c. **Imposed Load (Live Loads):** Live loads shall be as per IS – 875. For sloped roofs up to 10 deg. it shall be 0.75 KN/M².

d. **Wind Load**: Wind loads shall be as per IS: 875. The basic wind speed of the site is taken as 39 m/s. Values of coefficients K_1, K_2, K_3 shall be as $K_1 = 1.0$ for permanent structures. $K_3 = 1.0$, K_2 shall be taken for relevant class of the structure with Category 2 terrain with respect to the actual height of the structure. **The design life span of all structures shall be taken as 50 years.**

e. **Earthquake Load**: Seismic forces shall be as per IS:1893, ZONE III as applicable to Ranipet.

3. DETAILED ENGINEERING:

a. The contractor shall design the structures and prepare all the required drawings needed for correct and accurate construction.

b. Contractor shall submit his design calculations and 'Engineering Drawings' along with proof design to the Engineer in charge for his observations / comments. ALL DESIGN DRAWINGS NEED TO BE VETTED FROM IIT/IISC. Cost towards such vetting shall be in bidder's scope.

c. The contractor shall submit the design basis and General Arrangement (G.A) of the structure along with required explanatory sketches/drawings and get the same reviewed by BHEL before starting the final design and Ready for Construction (RFC) drawings. SEVEN days' time will be required by BHEL for approval.

d. Construction of the structure shall not be taken up at site till all the drawings are reviewed by BHEL, comments/suggestions given by BHEL are incorporated. And finally drawings are to be vetted from IIT/IISC.

e. BHEL reserves the right to review any/all or none of the designs and drawings. Review by BHEL shall not relieve the contractor of his responsibility for correct design and execution of the works.

f. The final design and RFC drawings shall directly adhere to the reviewed design basis and general arrangement and shall incorporate all the comments / suggestions given by BHEL without any extra cost to BHEL and any implication on time schedule for completion of work.

g. After the completion of erection and construction, the contractor shall submit to BHEL "As Built" drawings in 3 sets of copies as specified elsewhere.

h. The drawings shall include, but not be limited to: -

i. Detailed marking plans.
ii. Details member connections and connections to other structures and components of building.
iii. Detailed dimensions for fabrication indicating dimensional modifications required for field conditions
iv. Welding and bolting procedures to be used both at shop and field.
v. Cambers required to be provided, and permissible tolerances in fabrication.
vi. Assembly and Erection sequences indicating components to be connected at field.
vii. Complete bill of materials for each component (preferably drawing wise.)

i. Before submitting of drawings and calculations to the Engineer in-charge for his approval, these shall be checked and certified by the contractors own structural Engineer. Till such time shop detail of a component is approved, fabrication work for the component shall not be started.

j. If necessary and called for by the Engineer in charge, drawings shall be revised to suit modified requirements and these shall be resubmitted for approval of the Engineer in charge.

k. While the drawings prepared by the contractor, and approved by the Engineer in charge represent the correct interpretation of work to be done, the contractor is not relieved of his responsibilities for: -

i. Dimensional accuracy
ii. Correctness of engineering and design of connections
iii. Fit of parts
iv. Details
v. Errors or omissions
vi. Material and workmanship
vii. Methodology of fabrication and erection
viii. Safety of performance

4. APPLICABLE CODES AND STANDARDS:

a. The contractor shall make available at site all relevant Indian Standard Codes of practice as applicable and other relevant British/German/American Standard.

b. Apart from the IS Codes mentioned in particular for wind, live and earthquake loads in the various clauses of this specifications, all other relevant codes such as American standards (AISC, MBMA, AISI & AWS specifications) related to the specific job under consideration and / or referred to in the above mentioned codes may be followed wherever applicable, if the specifications for the same are not available in the relevant IS codes.

c. In case of discrepancy among Standard codes of practice the decision of the Engineer in charge will be final.

d. The codes and standards generally applicable to the work of this section are listed below. Latest revisions of the codes shall only be applicable.

IS-875 Part I:Code of Practice for Design Dead Loads for Building and Structures
IS-875 Part I:Code of Practice for Design Dead Loads for Building and Structures
IS-875 Part II:Code of Practice for Design Imposed Loads for Building and Structures
IS-875 Part III:Code of Practice for Design Wind Loads for Building and Structures
IS-1893 (2002): Criteria for Earth Quake Resistance Design Structures
IS-800 (2007):Code of Practice for General Construction in Steel. And all the codes listed in annex-A of the code
IS-801 (1975)::Code of Practice for use of Cold-Formed Light Gauge Steel Structure
IS-807 (2006): Design, Erection & Testing (Structural Portion) of Cranes and Hoists – Code of Practice.
IS-816 (1969): Code of Practice for use of Metal Arc Welding for General Construction.
IS: 102 Ready mixed paint, brushing, red lead non-setting, priming
IS: 104 Ready mixed paint, brushing, zinc-chrome, priming.
IS: 800 Code of Practice for General Construction in Steel
IS: 801 Code of Practice for use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.
IS: 806 Code of Practice for use of Steel Tubes in General Building Construction.
IS: 808 Dimensions of Hot Rolled Steel Beam, channel and angle sections
IS:811 Cold Formed Light Gauge Structural Steel Sections.
IS:813 Scheme of Symbols for Welding
IS:814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon-Manganese Steel
IS:816 Code of Practice of use of Metal Arc Welding for General construction in Mild Steel.
IS:818 Code of Practice for Safety and Health requirements in electric and Gas Welding and Cutting operations.
IS:822 Code of Procedure for Inspection of welds.
IS:875 Code of Practice for Structural Safety of Building, Loading Standards
IS:1024 Code of Practice for use of welding in Bridges and Structures Subject to Dynamic Loading.
IS:1120 Coach Screws
IS:1161 Steel Tubes for Structural Purposes
IS:1182 Recommended practice for Radiographic Examination of Fusion Welded Butt Joints in Steel plates.
IS:1363 Hexagon Head Bolts, Screws and Nuts (Grades –C)
IS:1364 Hexagon Head Bolts, Screws and Nuts (Grades A&B)
IS:1365 Slotted Counter-sunk Head Screws
IS:1367 Technical Supply condition for threaded fasteners.
IS:1852 Rolling and Cutting Tolerances for Hot Rolled Steel Products.

IS:1977 Low Tensile Structural Steel
IS:2016 Plain washers
IS:2062 Steel for General Structural Purposes
IS:2074 Ready Mixed Paint, Air drying, Red Oxide-Zinc chrome priming.
IS:3063 Fasteners-Single Coil Rectangular Section Spring Washers
IS:3443 Crane Rail Sections
IS:3600 Testing methods of fusion welded joints and weld metal in steel.
IS:3613 Acceptance tests for wire flux combination for submerged, arc welding.
IS:3757 High strength structural bolts.
IS:4000 Code of practice for high strength bolts in steel structures
IS:4923 Hollow Steel sections for structural use.
IS:5369 General Requirements for plain washers and lock washers
IS:5624 Foundation bolts.
IS:6227 Code, of practice for use of metal arc welding in tubular structures
IS:6623 High strength structural nuts.
IS:6639 Hexagonal bolts for steel structures.
IS:8500 Structural Steel Micro-alloyed (Medium and high strength qualities)

SECTION –D: FABRICATION AND ERECTION

1. TIME SCHEDULE AND SUBMITTALS:

a. The contractor shall submit within 7 days of issue of LOI "Time Schedule" for completion of various portions of works. This schedule is to be within the overall completion period of 12 months for the design, drawings, fabrication, supply and erection of structure. The detailed programmer in the form of a quantified bar chart or CPM network shall include all activities from start to completion.

b. Prior to the technical submittals, the contractor shall submit detailed baseline program and methodology indicating the proposed overall schedule for documentation such as calculations, shop/working drawings, plan/procedures and records. Submission of samples, process of fabrication / delivery to site storage yard for the approval of the Engineer in charge.

c. Complete fabrication drawings, materials list, cutting lists, bolt lists, welding schedules and QC schedules, based on the design drawing furnished to him and in accordance with the approved schedule.

d. Results of any tests, as and when conducted and as required by the Engineer in charge.

e. Manufacturer's mill test reports in respect of steel materials, bolts, nuts and electrodes, wires as may be applicable.

f. A detailed list of all constructional Plant & Equipment, such as cranes, derricks, winches, welding sets etc. their makes, model, present condition and location, available to the contractor and the ones he will employ on the job to maintain the progress of work in accordance with the contract.

g. The total number of experienced personnel of each category, like fitters, welders, riggers etc., which he intends to deploy on the project.

2. FABRICATION:

a. Contractor shall use his own premises / workshop for fabrication of structural steel work

b. All fabrication work shall be done in accordance with relevant IS codes.

c. Fabrication shall be done in workshops approved by Engineer in charge, unless specifically permitted by Engineer in charge that fabrication can be done at site. Under such circumstances work shall be done on a specially designed and constructed platform. Location, size, specification and construction of such a platform shall have prior approval of Engineer in charge. Loads associated with such platforms shall be provided to Engineer in charge.

d. Mild steel rolled sections and plates shall be cut by shearing/machining and grinding the surfaces to true sizes and shapes. Gas cutting of mild steel may be permitted by the Engineer in charge, provided that every cut face and edge is smoothened by grinding operation. Prior approval of Engineer in charge must be obtained for using gas-cutting techniques either by mechanized gas cutters or manually operated gas cutters. While, using gas-cutting methods, proper allowance must be made for grinding to bring the cut piece to exact required dimensions.

e. Extensive use of templates shall be made in doing fabrication work. Templates shall be clean and should have true surfaces prepared for every successive use. Reinforcements for the structural steel members if required shall be included. In case actual members are used as templates for similar pieces are fit to be incorporated in the finished structure. Jigs and manipulators shall be used, where practicable, and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

f. All material shall be straight and free from twist and bends unless required to be curvilinear in from. If necessary, the material shall be straightened and / or flattened/straightened by pressure. Heating of rolled sections and plates for purpose of straightening shall not be permitted.

g. Curvilinear members shall be formed by bending with the help of pneumatic press. Final shaping, to a very limited extent, however, may be done by local heat application. This shall be done only on receiving approval from the Engineer in charge.

h. HOLING: All holes shall be made at right angles to the surface of the member. Holes shall be clean cut without any torn or jagged edges. Holes shall be done by drilling. Punching shall not be resorted to, unless previously approved by the Engineer. In any case, punching of holes in materials having a thickness in excess of the connector diameter, or, for materials thicker than 16mm, the hole shall be punched 3mm less in diameter than the required size and then reamed to the full size. Holes shall not be formed or enlarged by burning or gas cutting under any circumstances.

3. ERECTION:

a. Erection of structural steel fabricated components shall be done in accordance with provisions of relevant IS Codes.

b. Erection of all structural works, roofing, cladding, framed openings etc., including supply of all materials, labor, supervision, plant, tools and tackles etc., shall be carried out by the Contractor at site.

c. Erection of Pre-Engineered Building shall be done in the presence / guidance of PEB Manufacturing experts.

d. Foundation Bolts shall be fixed and grouted by the other civil contractor. The alignment and levels are to be checked and certified by the PEB Manufacturer's Engineer.

e. No welding is permitted at site unless otherwise cleared by the Consultant/BHEL.

f. Before starting of erection work, the contractor shall ensure the fulfillment of the following activities: -

i) The contractor shall submit, for examination by the Engineer in charge, detailed particulars of his proposed methods of erection of the superstructure steel work, together with complete calculations relating to strength and deflection, if the erection scheme necessitates the attachment of strength steel work to the permanent steel work, the contractor shall submit, for approval of the Engineer in charge, the methods he proposes for making good the permanent steelwork after removing the temporary work. The contractor shall also submit the design and fabrication drawings including detailed calculations of temporary nose, counter weight all temporary support, staging, braces etc. required for safe erection, for approval of the Engineer in charge.

ii) The contractor shall provide all construction and transport equipment, tools, tackle and consumables, materials, labor and supervision required for the erection of the structural steel work.

iii) Handing, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer in charge.

iv) Setting out, aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the erection scheme or as directed by the Engineer in charge.

4. MATERIALS- STEEL SUPPLIED BY THE CONTRACTOR:

a. The Contractor shall furnish to the Engineer in charge all mill orders covering the material ordered by him for this work and also the test reports received from the Mills for his approval and information. It is not intended that all the steel materials to be supplied by the Contractor for the work shall be specially purchased from the APPROVED rolling mills LIKE STEEL AUTHORITY OF INDIA LTD.(SAIL), TATA STEEL, JSW STEEL ETC. The Contractor's stock material may be used, provided the mill test reports identified with the materials, satisfactorily demonstrate the specified grade and quality. The Engineer in charge shall have the right to test random samples to prove authenticity of the test certificates produced by the Contractor, at the Contractor's cost.

b. All steel materials supplied by the Contractor shall be in a sound condition, of recent manufacture, free from defects, loose mill scale, slag intrusions, laminations, pitting, flaky crust, etc. and be of full weight and thickness specified.

c. Wherever the Contractor, in order to accommodate his other materials in stock, desires to substitute structural steels or plates for the sizes shown on drawings, such substitutions shall be made only after authorization in writing by the Engineer in charge.

d. The Engineer in charge may direct that substitution be made, when he considers such substitution is necessary.

5. MATERIAL HANDLING AND STORAGE:

a. Proper storage of steel (sections and fabricated members) at the job site shall be the responsibility of the Contractor.

b. Structural steel shall be stored out of mud and dirt. Proper drainage of the storage area shall be provided. These shall be protected from damage or soiling by adjacent construction operations.

c. Fabricated steel shall not be handled until the paint has thoroughly dried. Care shall be taken to avoid paint abrasions and other damage. Teel work shall be transported in such a way so as not to over stress the fabricated sections. All pieces bent or otherwise damaged shall be rejected and shall be replaced by the contractor at his own cost.

d. Checking and inspection of fabricated structural steel work by the Engineer in charge shall be done at various stages of completion of fabrication work. The contractor is required to ensure that fabricated steel work is properly stacked such that all joints of all members are either visible or accessible for inspection at all stages of inspection work. Care should also be taken to ensure that fabricated members are not subjected to stresses due to defective stacking.

6. WELDING:

a. In general, only Automatic submerged arc welding will be used for fabrication. Subject to approval of Engineer in charge, Metal inert gas welding may be done for short length where access to the location of the weld does not permit submerged arc welding. The welding and the welded work shall conform to IS:816, unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of operations shall be so arranged as to eliminate distortion and shrinkage stresses.

b. Electrodes for shielded-arc manual welds shall comply with the requirements of IS: 814 and shall be amenable to radiographic tests and shall be of approved make. The electrodes for manual arc welding shall be suitable for use in the position and type of work, as laid down in the above specifications and as recommended by the manufacturers. Electrodes classification group 1 or 2 as given in IS: 814 shall be used for welding steel conforming to IS:2062. Electrodes shall conform to IS-1442 for steel conforming to IS: 8500. Joints in materials above 20mm thick, and, all important connections shall be made with low hydrogen electrodes Electrode flux covering shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Covered electrodes for manual arc-welding shall be properly stored in an oven prior to use in a manner recommended by the Manufacturer and only an hour's quota shall be issued to each welder from the oven.

c. Electrodes larger than 5mm diameter shall not be used for root-runs in butt-welds. Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality, the Contractor shall maintain all welding plant in good working order. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.

d. All welds shall be made only by welders and welding operators who have been properly trained and previously qualified by tests to perform the type of work required as prescribed in the relevant applicable standards.

e. All welds shall be free from defects like below holes, slag inclusions, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal, feather edges without overlap and freedom from porosity.

f. Fusion faces and surfaces adjacent to the joint for a distance of at least 50 mm on either side shall be absolutely free from grease, paint loose scales, moisture or any other substance which might interfere with welding or adversely affect the quality of the weld. Joint surfaces shall be smooth, uniform and free from fins, tears, laminations etc. Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or machine flame cutting except that shearing shall not be used for thickness over 8mm

g. In the fabrication of cover-plated 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 re-enforcement interferes with proper fit-up between components to be assembled for welding, these welds shall be ground flush prior to assembly.

h. Members to be joined by fillet welding shall be brought and held a 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. This shall only apply in the case of continuous welds. The fit-up of joints at contact surfaces which are not completely sealed by welds shall be close enough to exclude water after painting.

i. The separation between fraying surfaces of lap joints and butt joints with backing plate shall not exceed 1.5mm. Abutting parts to be butt welded shall be carefully aligned and the correct root gap maintained throughout the welding operation. Misalignments greater than 25 percent of the thickness of the thinner plate or 3mm whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 degrees (1in 27.5)

j. Welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. A welding procedure shall be prepared by the Contractor and submitted to the Engineer in charge for approval before start of welding.

k. Approval of the welding procedure by the Engineer in charge shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

l. Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the Manufacturer of the electrode being used, and suitable to thickness of material, joint etc. The work shall be positioned for flat welding wherever practicable and overhead weld shall be avoided.

m. No Welding shall be done when the surface of the members is wet, not during periods of high wind unless the welding operator and the work are properly protected. In joints connected by fillet welds, the minimum sizes of single run fillet welds or first runs and minimum full sizes of fillet welds shall conform to the requirements of IS:816 and IS:823, Fillet welds larger than 8mm shall be made with two or more passes.

n. All ‘full penetration butt welds’ made by manual arc-welding, except when produced with the aid of backing material or welded in flat position, from both sides in square-edge material, not over 8mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross section.

o. Butt welds shall be terminated at the ends of a joint in a manner that will ensure their soundness where abutting parts are 20mm or more in thickness, run-on and run-off plates with similar edge preparation end having a width not less than the thickness of the thicker part joined shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the ends 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.

p. Each layer of a multiple layer weld except root and surface runs may be moderately peeled with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from over-peeling.

q. Before commencing fabricating of a member or structure in which welding is likely to result in distortion and/or locked up stresses, a complete programmer of fabrication, assembly and welding shall be made and submitted to the Engineer in charge for his approval. Such a programmer shall, include, besides other appropriate details, full particulars in regard to the following: -

i) Proposed pre-bending of components such as flanges and presetting of joints to offset expected distortion.
ii) Make up of sub-assemblies proposed to be welded before incorporation in final assembly.
iii) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequence with directions in which freedom of movement is to be allowed.
iv) Proposed number, spacing and type of strong details of jigs and fixtures for maintaining proper fit up and alignment during welding.
v) Any other special features like assembling similar members back to back or stress relief.

r. If so desired by the Engineer in charge, mock up welding shall be carried out at the contractor's cost to establish the efficacy of the proposed programmer, with any modification suggested by the Engineer in charge in limiting distortion or/and residual stress to acceptable levels. Such modifications will not relieve the contractor of any of his responsibilities.

s. The ends of butt joints shall be welded so as to provide full throat thickness. This may be done by the use of extension pieces, cross-runs or other approved means. The weld face shall, at all places, be deposited projecting the surface of the parent metal. Where a flush surface is required, the surplus metal shall be dressed off. Splices and butt joints of compression members, depending on contact for stress transmission, shall be accurately machined over the whole section. In column bases, the ends of shafts together with the attached gussets, angles, channels etc., after bolting and/or welding together as the case may be, shall be accurately machined so that the parts connected butt over the entire surface of contact. Care shall be taken that connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 0.80mm.

t. The minimum leg length of a fillet weld as deposited shall be not less than the specified size. In no case shall a concave weld be deposited, unless specifically permitted. Where permitted, the leg length shall be increased above that specified length, so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat-faced weld of the specified leg length.

u. After making each run of welding, all slag shall be thoroughly removed and the surface cleaned. The weld metal, as deposited (including tack welds), shall be free from cracks, slag inclusions, porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without under cutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

7. INSPECTION OF WELDS:

a. All welds shall be inspected for flaws by any of the methods described in these Specifications, and as per IS: 822. The choice of the method to be adopted, shall be determined by the Engineer in charge.

b. The contractor shall arrange for all tests as called for, at his own cost.

c. In case the tests uncover defective work, such tests shall be at the Contractor's cost and the Contactor shall correct such defects at his own cost and prove the soundness of rectified work.

d. The correction of defective welds shall be carried out as directed by the Engineer in charge without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the Engineer in charge 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 operations incidental to correction shall be to the Contractor's account.

8. FIELD BOLTS:

a. Requirements stipulated under bolting shall apply for field bolts also. Field bolts nuts and washers shall be furnished by the contractor in excess of the nominal numbers required. He shall supply the full number of bolts, nuts and washers and other necessary fittings required completing the work, together with the additional bolts, nuts and washers totaling to 10% of the requirement subject to minimum of 10 Nos.

b. At the time of assembly, the surfaces in contact shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating or the parts or would interfere with the development of friction between them.

c. If any other surface condition, including a machined surface, is specified, it shall be the responsibility of the Contractor to work within the slip factor specified for the particular case.

d. Each bolt and nut shall be assembled with washers of appropriate shape, quality and number in cases where plane parallel surfaces are involved, such washers shall be placed under the bolt head or the nut, whichever is to be rotated during the tightening operation. The rotated nut or bolt head shall be tightened against a surface normal to the bolt axis, and the appropriate tapered washer shall be used when the surfaces are not parallel. The angle between the bolt axis and the surface under the non-rotating component (i.e. the bolt head or the nut) shall be 90+3 degree. For angles outside these limits, a tapered washer shall be placed under the non-rotating component. Tapered washers shall be correctly positioned.

e. No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nut and bolts shall always be tightened in a staggered pattern and where there are more than four bolts in anyone joint, they shall be tightened from the center of the joint outwards.

f. If after final tightening, a nut or bolt is slackened off for any reason, the bolt, nut and washer or washers shall be discarded and not used again.

9. ASSEMBLY:

a. All parts assembled for bolting shall be in close contact over the whole surface.

b. The component parts shall be so assembled that they are neither twisted nor otherwise damaged, specified cambers, if any, shall be provided.

c. All parts of bolted and welded members shall be held firmly in position by means of jigs or clamps while bolting or welding. No drifting of holes shall be permitted, except to draw the parts together and no drift used shall be larger than the nominal diameter of the bolt. Drifting done during assembling shall not distort the metal or enlarge the holes.

d. Trial assemblies shall be carried out at the fabrication stage to ensure accuracy of workmanship, and these checks shall be witnessed by the Engineer in charge/Authorized inspecting agency. Such trial assembly shall be at the cost of the contractor.

10. FABRICATION TOLERANCES: Unless otherwise shown on drawings, the fabrication tolerances shall generally be as detailed hereunder.

a. **STRAIGHTNESS:** The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852 for indigenous steel and equivalent applicable codes for imported steel. The acceptable limits for straightness (sweep and camber) for rolled or fabricated members shall be: -

Struts and columns: L/1000 or 10mm whichever is smaller.

For all other members not primarily in compression such as purlins, beams, bracings & web members of trusses and latticed girders: L/500 or 15mm whichever is less. (Where L is the length of finished member, or such lesser length as the Engineer in charge may specify).

b. **TWISTS:** A limit of twist (prior to erection) in: -

Box girders and heavy columns: L/1500

Other members: L/1000

c. **CAMBER:** Tolerance in specified camber of structural members shall be ±3 mm.

d. **LENGTH:** Tolerance in specified length shall be as follows: -

Type of member	**Tolerance**
A column finished for contact bearing	: ± 1 mm
Other members (e.g. beams) under 10 m	: + 0 and -3mm
Other members (e.g. beams) 10 m long and over	: + 0 and -5mm

e. **SQUARE-NESS AT END OF MEMBERS:** Beam to beam and beam to column connections where the abutting parts are to be joined by butt welds, permissible deviation from the square-ness of the end is: -

Beams up to 600 mm in depth: 1.5mm

Beams over 600 mm in depth: 1.5mm every 600 mm depth up to a max of 3 mm

Where abutting parts are to be joined by bolting through cleats or end plates, the connections require closer tolerance.

Beams up to 600 mm in depth: 1.0 mm

Beams over 600 mm in depth: max of 1.5mm

f. **BUTT JOINTS:** For full bearing, two abutting ends of columns shall first be aligned to within 1 in 1000 of their combined length and then the following conditions shall be met:

Over at least 80% of the bearing surface the clearance between the surfaces does not exceed 0.10 mm.

Over the remainder of the surfaces the clearance between the surfaces does not exceed 0.30 mm.

Where web stiffeners are designed for full bearing on either the top flange or bottom flange or both, at least half the stiffener shall be in positive contact with the flange. The reminder of the contact face could have a max. gap of 0.25mm.

g. **DEPTH OF MEMBER:**

Acceptable deviation from the specified overall depth is:

For depths of 900 mm and under: ± 3mm.

For depths over 900 mm and under 1800mm: ± 5mm

For depths of 1800 mm and over: +8 mm: - 5mm

h. **WEB PLATES:** Acceptable deviation from flatness in girder webs in the length between the stiffeners or in a length equal to the girder depth shall be $1/150^{th}$ of the total web depth.

i. **FLANGE PLATES:** Limit for combined warp-age and tilt on the flanges of a built up member is 1/200 of the total width of flange or 1.5 mm whichever is smaller measured with respect to center line of flange.

j. Lateral deviation between center line of web plate and center line of flange plate at contact surfaces, in the case of built up sections shall not exceed 3 mm.

k. **Column Fabrication Tolerances**: The work point at about the elevation of the crane girders seat shall not be vary more than $\pm 1/8^{th}$ inch from the straight line struck between top and bottom points. The AWS straightness tolerances will control between the work points. The girder seat plates are to be located from the work center line with a tolerance of ±1/32 inch. Or equivalent aisc/mbma manual.

l. **]Crane Runway Girder Fabrication tolerances**:

Crane Girders: Horizontal sweeps in crane runway girders shall not exceed $1/4^{th}$ inch per 50 feet length of girder span. Camber shall not exceed ± $1/4^{th}$ inch per 50 feet girder span over that indicated on the design drawing.

m. **Girder ends**: The ends of the girder supported by the columns, the bottom flange shall be flat and perpendicular to the web. The flatness tolerance shall be ±1/32 inch at any point supported by the column cap plates.

n. **Crane Girder alignment**: The center line top of each crane girder at each column shall be aligned horizontally within $\pm 1/4^{th}$ inch of the theoretical base lines both sides of the runway.

SECTION –E: INSPECTION AND TESTING

1. QUALITY CONTROL & TESTING REQUIREMENTS: The contractor shall submit the following:

a. Quality plan for approval for fabrication as well as erection.

b. Proposed overall schedule for documentation of shop drawings, plan/procedures and records, submission of procedure of fabrication.

c. The contractor shall himself inspect all materials and shop work to satisfy the specified tolerance limits and quality norms before the same are inspected by Engineer in charge.

d. The contractor shall through appropriate planning and continuous measurements in the workshop and the erection at site ensure that the tolerances specified in this specification are strictly adhered to.

2. INSPECTION:

a. The contractor shall give due notice to the Engineer in charge in advance if the materials or workmanship getting ready for inspection.

b. No materials shall be painted or dispatched to site without inspection and approval by the Engineer in charge unless, such inspection is waived in writing by the Engineer in charge.

c. All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer in charge's approval / inspection. The fact that certain material has been accepted at the Contractor's shop shall not invalidate final rejection at site by the Engineer in charge, if it fails to be in proper conditioner has fabrication in accuracies which prevents proper assembly.

d. Shop inspection by the Engineer in charge or his authorized representative, or submission of test certificates and acceptance thereof by the Engineer-in-charge, shall not relieve the Contractor from the responsibility of furnishing material conforming to the requirements of these specifications. Nor shall it invalidate any claim, which the Engineer in charge may make because of defective or unsatisfactory material and/or workmanship.

e. The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified. For fabrication work carried out in the field, the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer in charge.

3. TESTING:

a. **MATERIAL TESTING:** If mill test reports are not available for any steel materials, the same shall be got tested by the contractor to the satisfaction of Engineer in charge to demonstrate conformity with the relevant specification.

b. **TESTS ON WELDS:** Fabricating agency shall have in house facilities for all testing of weld.

i) **MAGNETIC PARTICLE TEST:** Only where the Engineer in charge requires that flaw-detection of welds be done by 'magnetic particle test', in such cases the tests are to be done in accordance with IS:3703. if heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and re-tested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the explicit written permission of the Engineer in charge.

ii) **DYE PENETRATION TEST:** Where welds are required to be examined by dye penetration inspection method, such tests shall be carried out in accordance with IS:3658.

iii) **RADIOGRAPHIC INSPECTION:** Whether instructed by Engineer in charge, or not, all 'Butt' welds shall be inspected by radiographic examination method. Such examination shall be done in accordance with the recommendations of IS:1182.

c. **TEST FAILURE:** At any stage, in the event of any material or work failing to meet an inspection of test requirement, which is not overseen by the Engineer in charge, the Contractor shall notify the

Engineer in charge immediately. The contractor must obtain permission from Engineer in charge before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer in charge. The Engineer in charge has the right to specify additional inspection or testing as he deems necessary, and the additional cost of such testing shall be borne by the Contractor. The Contractor shall maintain records of all inspection and testing which shall be made available to the Engineer in charge on demand.

d. **SHOP ASSEMBLY:** Some steel work, particularly columns along with tie beams, bracings etc. may have to be shop assembled to ensure satisfactory fabrication, if the Engineer in charge so desires, he may order such assembly at shop for verification. The Contractor shall comply with such instructions without claiming any extra cost. Steel work shall be temporarily shop assembled, as necessary, so that the accuracy of fit may be checked before dispatch. The parts shall be shop assembled with a sufficient number of parallel drifts to bring and keep the parts in place.

e. Since parts drilled or punched, with templates having steel bushes shall be similar and, as such, interchangeable, such steel work may be shop erected in part only, as agreed by the Engineer in charge.

4. MARKING OF MEMBERS:

a. After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible, even after a member is galvanized.

b. All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt-holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location. Erection marks on like pieces shall be at identical location. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

c. Each fabricated member, whether assembled prior dispatch or not so assembled, shall bear an erection mark, which will help to identify the member and its position in respect of the whole structure, to facilitate re-erection at site. This erection mark shall be incorporated in the shop detail and erection drawings.

5. ERRORS: Any error in shop work which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer in charge as defective workmanship. All charges incurred by the Engineer either directly or indirectly because of the poor workmanship will be deducted from the amount due to the contractor before payment is made. The amount of such deduction will consist of the sum total of the costs of labor direct or indirect, material, plant, transportation, equipment rental and overhead expenses. In case the Engineer chooses to reject the material because of poor workmanship, the cost of all handling and returning the material to the contractor, if he so desires, shall entirely be the contractors account. All the replacement materials shall be supplied free and in all such cases, the cost of handling, transport and delivery to site shall be borne by the contractor.

6. VISUAL EXAMINATION: The contractor shall conduct visual examination and measurement of the external dimensions of welds for all joints. Before examining the welded joints, areas close to it on both sides of the weld for a width not less than 20 mm shall be cleaned of slag and other impurities. Examination shall be done by a magnifying glass which has a magnification power of ten (10) and measuring instrument which has an accuracy of ± 0.10 mm or by weld gauges. Welded joints shall be examined from both sides. The contractor shall examine the following during the visual checks.

i) Correctness and shape of the welded joints
ii) Incomplete penetration of weld metal
iii) Influx
iv) Burns
v) Un welded craters
vi) Undercuts
vii) Cracks in welded spots and heat affected zones
viii) Porosity in welds and spot welds.
ix) Compression in welded joints as a result of electrode impact while carrying out contact welding
x) Displacement of welded element.

The contractor shall, document all data as per sound practices. In order to exercise proper control of the quality of the welding, contractor shall enforce methods of control as tabulated below:

Purpose	Control subjects	Methods of control
1	2	3
1. control of welding materials and basic metal quality 2. Checking of welder's qualifications 3. Control of welded joint quality	Quality control of electrodes, welding wire, flux and protective gases. Welding of specimens for quality determination. Control of assembly accuracy and technological welding process.	Weld ability test to determine the technological properties of materials. Mechanical test of weld metal. Metallographic investigations of welds macro-structure and microstructure. Checking of weld metal resistance for inter-crystalline corrosion. Study if weld metal solidity by physical control methods. Mechanical tests, metal graphical investigation & checking of welded joints by physical control methods Checking of assembly quality & centering of welded members. Checking of welding equipment conditions. Checking corrective ness of welding procedure. Visual examination of welds.

SECTION- F: MATERIAL & PAINTING SPECIFICATIONS

1.0 MATERIAL

1.1 SPECIFICATIONS

1.1.1 Primary members fabricated from plates and sections with minimum yield strength of 345 Mpa or to suit design by continuous welding.

1.1.2 Secondary members for Purlins and Grits shall conform to the physical specification of ASTM A570 (Grade 50) or equivalent IS Standards having a minimum yield strength of 345 MPa. The minimum thickness of secondary members shall be 2.5mm.

1.1.3 Rod /ANGLE bracing shall conform to the physical specification IS 2062.OF MIN 245MPA YIELD STRENGTH

1.1.4 All hot rolled sections shall conform to the physical specifications IS 2062. All other miscellaneous secondary members shall have minimum yield strength of 250 MPa.

1.2 **DESCRIPTION**

1.2.1 **PRIMARY MEMBERS:**

Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns and crane gantry girders and Frames at Door openings.

1.2.2 **SECONDARY MEMBERS**:

Secondary structural framing shall include the purlins, girts, eave struts, wind bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

1.2.3 **PURLINS:**

Purlins should be of Pre Galvanized steel of 345 Mpa having a coating thickness of 275 gsm

1.2.4. **ROOF SHEETING:**

Roof panels shall be made out of 26-gauge high tensile steel double lock standing seam profiled sheets having min. yield strength of 345 Mpa conforming to ASTM-A607 with galvalume coating to AZ-150 bare galvalume, as per ASTM A-792-AZ to make TCT of 0.47mm. The profile shall be trapezoidal shaped to satisfy the loading requirements or any other profile if proved to have sufficient strength to take DL, LL, wind loads.

1.2.5 **Wall Panels**

Wall panel material specifications shall be same as roof panels. They shall be polyester coated of approved standard colour.0.5 TCT The profile shall have a maximum pitch of 200mm and minimum depth of 26 mm. Alternatively maximum pitch of 333mm with two intermediate stiffening ribs will be acceptable or any other profile if proved to have sufficient strength to take the relevant wind loads.

1.2.6 **SHEETING FASTENERS**:

Standard fasteners shall be self-tapping zinc plated metal screws with EPDM bonded zinc plated washers. All screws shall be color coated to match roof and wall sheeting.

1.2.7 **SEALER**:

This is to be applied at all side laps and end laps of roof panels and around self-flashing windows. Sealer shall be pressure sensitive elastomeric Butyl tapes. The sealer shall be non-asphaltic, non-shrinking and nontoxic and shall be superior adhesive metals, plastics and painted at temperatures from 51°C to +104°C.

1.2.8 **CLOSURES**:

Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations specified on drawings.

1.2.9 **FLASHING AND TRIM:**

Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Color shall be matching with the color of wall. Material shall be 26 gauge thick conforming to the physical specifications of sheeting.

1.2.10 SKY LIGHTS:

Skylight is translucent corrugated sheets matching the profile of Roof. The translucent sheets are made from 2mm thick Polycarbonate sheets and shall provide an economic form of general-purpose day lighting. Skylights shall be provided for 5% of the roof area. Color of the panel shall be white with smooth surface finish with a light transmitting capacity of 60% $\pm$ 5%.

1.2.11 GUTTERS AND DOWN SPOUTS:

Gutters and downspouts shall be adequately designed to ensure proper roof drainage system. Material shall be same as that of sheeting.

1.3 **CONNECTIONS:**

1.3.1 SITE CONNECTIONS

a) All primary bolted connections shall be provided with galvanized high strength bolts, washers, nuts conforming to specifications of grade 8.8 OF IS 1367

b) All secondary bolted connections shall be furnished with bolts, nuts, washers conforming to the specifications of grade 4.6 of IS 1367 or ASTM-A307.

1.3.2 SHOP CONNECTIONS

All shop connections shall be welded with appropriate arc welding process and welding shall be in accordance with IS 816, IS-819, IS1024, IS-1261, IS1323, IS-9595, AWSD 1.1. as appropriate. **The Webs should be welded on to the flanges at both the faces at top and bottom for columns, beams and crane girders.** Weld material should have strength more than the parent metal.

1.4 ROOF & WALL BRACINGS

Roof and wall bracings shall have a minimum yield strength of 250 Mpa and shall conform to the specifications IS 2062.
Portal Bracing connecting columns should be min. at one place on both the side walls.

1.5 **PAINTING FOR STRUCTURAL STEEL WORK**:

The cleaning & painting specifications for the Structural Steel work shall be as below

a) Sandblasting / shot blasting to SA 2.5.

b) One shop coats of zinc chromate primer (1 x 40 μ)
c) Three coats of intumescent coating to a total thickness of 750 microns after erection of the structures.
d) 2 top coats as per the instruction of the manufacturer / Engineer – in – charge to protect the intumescent coatings.

SECTION- G: SAFETY PRECAUTIONS

1. **GENERAL SAFETY PRECAUTIONS TO BE FOLLOWED AT WORK SITE DURING EXECUTION:** The following safety measures should be strictly adhered to during execution of works at sites.

a. Providing the working platform with toe board and handrail for continuous working at heights.
b. Providing safety belt and life line at all times for men working at heights.
c. Providing dust or fume respirator in places where dust and fume concentration exists.
d. Providing goggles and welding screens.
e. Providing acid and alkali proof rubber gloves for handling acid and alkali and chemical which are corrosive.
f. Providing rubber gloves for working on electrical works.
g. Ensuring proper lashing of the components while being transported in vehicles.
h. The vehicles must have side supports or have body to support the materials conveyed.
i. The materials should not be allowed to extend or overflow the sides of the vehicles.
j. Materials should not be allowed to overhang from the rear edge of the body of the vehicle.
k. Driver of the vehicle must possess valid license.
l. Vehicle must not be overloaded beyond prescribed limits.
m. Red flags and lights for parts projecting from the body of vehicle must be provided.
n. The speed restrictions within the factory premises must be strictly adhered to.
o. The gas cylinders must be always handled on trolleys or kept tied down not in use. They should never be rolled as Roller for conveying.
p. Cylinders should not be used without regulators.
q. All excavations must be barricaded and red lamps / tapes must be provided.
r. All electrical connections must be properly earthed.
s. No work should be taken up for execution inside shop floor, without obtaining necessary work permit.
t. Providing helmet, safety belt, safety shoes etc., for high level work and sufficient number of Industrial Safety nets at appropriate level to safeguard the persons working at high level particularly in trusses, girders, roofing etc., of industrial and high roof buildings.
u. The contractor should maintain a register regarding the driver license particulars.
v. All personal protective equipment conforms with standard specification as per the details given in the code of conduct.
w. Contractor including their sub-contractors, agents and labor engaged on the work are required to scrupulously adhere to the safety regulations, safety precautions and measurers. Any violation thereof will invite punitive action being taken against them. Also contractors with frequent violations of safety regulations will not be entrusted with further work in this organization.

2. **SAFETY PRECAUTIONS TO BE OBSERVED WHILE TRANSPORTING MATERIALS: VEHICLE:**

a. Vehicles carrying material should have proper registration documents and must be produced on demand by our Security Staff.
b. The light on right side, i.e., over the driver's cabin shall be in working condition.
c. Both the head lights as well as park lamps must be in working conditions.
d. The vehicles should have valid smoke emission test conducted before entering the site premises and should the same be produced to security/safety personnel if required.
e. **MOVEMENT OF VEHICLE:**
   i) The vehicle should not travel at more than 20 km.ph in BHEL premises.
   ii) The Driver of the vehicle must possess heavy duty license and produce on demand by the Security Staff.
   iii) Vehicles carrying inflammable liquids in the tank containers should have grounding chain or the tank should be coated with insulating material also to avoid Static Electricity.
   iv) In road junctions, speed breakers and railway crossing, the speed should be lowered and vehicle should proceed cautiously.
   v) The driving should 'KEEP TO THE LEFT' at all places.
   vi) The vehicle should not be parked in road which could obstruct the vehicular traffic.
   vii) No person other than driver should be allowed to sit or stand on the prime mover or trailer.
   viii) The vehicle should pass only through the approved routes. Short cuts should be forbidden.
   ix) There must be a safe distance behind another moving truck.
   x) The driver should avoid making quick starts, jerky stops or quick turns at excessive speed.