

POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

STANDARD FIELD QUALITY PLAN FOR SWITCHYARD CIVIL WORKS

Section : FOUNDATION MATERIALS

Sl. No.	Component/Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	Check
1.	CHECKING OF FOUNDATION MATERIALS					
A)	CEMENT					
i)	Fineness	One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing	IS:456, IS:269	Manufacturer/ POWERGRID approved lab	Review of manufacturers test certificates (MTCs) and laboratory test results by POWERGRID	B
ii)	Compressive Strength		IS:8112, IS:12269			
iii)	Initial & final setting time		IS:1489 & POWERGRID specification			
iv)	Soundness					
v)	Heat of Hydration for low heat cement (Not applicable for OPC & PPC)					
vi)	Chemical Composition of Cement	One sample per lot of 100 MT or part thereof from each source for MTCs	IS:456, IS:269 IS:8112, IS:12269 IS:1489 & POWERGRID specification	Manufacturer	Review of manufacturers test certificates by POWERGRID	B
B)	COARSE AGGREGATES					
i)	Determination of Partical size (Sieve Analysis)	One sample per lot of 100 cubic meter or part thereof from each source for each size	IS:383, IS:2386 and POWERGRID specification	POWERGRID approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to be approved by POWERGRID Review and acceptance of test result by POWERGRID.	B
ii)	Flakiness Index					
iii)	Crushing Value					
iv)	Specific Gravity*					
v)	Bulk Density*					
vi)	Absorption Value*					
vii)	Moisture Content*					
viii)	Soundness of Aggregate**					
ix)	Presence of deleterious materials					
	* Applicable Design concretes only	** Applicable to concrete work subject to frost action				

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C)	FINE AGGREGATE					
i)	Gradation/Determination of Particle size (Sieve Analysis)	One sample per lot of 100 cubic meter or part thereof from each source	IS:383,IS:2386,IS:456 and POWERGRID specification	POWERGRID approved lab. However Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to be approved by POWERGRID Review and acceptance of test result by POWERGRID.	B
ii)	Specific Gravity and density					
iii)	Moisture content					
iv)	Absorption Value					
v)	Bulking					
vi)	Silt Content Test					
vii)	Presence of deleterious materials					
D)	BRICKS					
i)	Dimensional tolerance	As per enclosed Annexure-II	CPWD & POWERGRID specification	POWERGRID approved Lab.	Approved by POWERGRID	B
ii)	Compressible Strength					
iii)	Water Absorption					
iv)	Efflorescence					
E)	WATER					
i)	Cleanliness (Visual Check)	Random	IS:456, IS:3025 and POWERGRID specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalies, organic materials, or other deleterious materials	Contractor	Each source to be approved by POWERGRID	B
ii)	Chemical and physical properties of water for checking its suitability for construction purposes	One sample per source	IS:456, IS:3025 and POWERGRID specification	Contractor/ POWERGRID Approved Lab	Approved by POWERGRID	B
	*Applicable to design mix concretes only					

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Sl. No.	Component/Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	Check
1.	REINFORCEMENT STEEL					
i)	Identification & size	Random	IS:432, IS:1139, IS:1786 & POWER GRID specification	Contractor	Approved by POWERGRID	B
ii)	Chemical Analysis Test	One sample per heat	IS:432, IS:1139, IS:1786 POWERGRID specification	Manufacturer	Review of manufacturers test certificates by POWERGRID	B
iii) iv) v)	Tensile Test Yield stress/proof stress Percentage Elongation	One sample per lot of 40 MT or part thereof for each size of steel conforming to IS: 1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS: 432. For steel as per IS:1786 under 10mm 1 sample for each 25 MT or part thereof. 20 mm-16 mm 1 sample for each 35 MT or part thereof. Over 16mm 1 sample for each 45 MT or part thereof	IS:432, IS:1139, IS:1786 POWER GRID specification	Manufacturers/ POWERGRID approved lab	Review of manufacturers test certificates as well as lab test results by POWERGRID	B
vi)	Bend/Rebend Test	One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm-16mm 1 sample for each 25MT or part thereof 10 mm-16mm 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 POWER GRID specification	Manufacturers/ POWERGRID	Review of manufacturers test certificates as well as lab test results by POWERGRID	B
vii)	Reverse Bend Test for HDS wire	One sample per lot of 5 MT or part thereof for each size	IS:432 POWER GRID specification	Manufacturer/ POWERGRID approved lab	Review of manufacturers test certificates as well as lab test result by POWERGRID	B

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Section : FOUNDATION

Sl. No.	Component/Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	Check
C.	STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS					
i)	Dimensional Check	Random	POWERGRID Specification & approved drawing	Contractor	Checklist to be prepared and signed jointly	B
ii)	Visual Check for damages, rusting, Pitting etc.	100%	POWERGRID Specification & approved drawing	Contractor	Checklist to be prepared and signed jointly	C
iii)	Visual Check for welding, defects, primer, coating and painting/galvanizing as applicable	Random	POWERGRID specification & approved drawings	Contractor	Checklist to be prepared and signed jointly	C
iv)	Physical properties of structural steel	1 sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size.	IS:2062, POWERGRID specification & approved drawings	Manufacturer/ POWER GRID Approved lab	Review of Mfgs. Test certificates as well as lab test results by POWERGRID	B

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Sl. No.	Component/Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	Check
2.	GANTRY/EQUIPMENT FOUNDATION/ CABLE TRENCH					
A.	BEFORE EXCAVATION					
i)	Checking of pegs condition as per line and alignment	100% on each location	IS:4091, IS:3764 & POWERGRID approved drawings/specification	Contractor	Approval by POWERGRID	C
ii)	Checking of pit making as per drawing & RL	100% on each location	IS:4091, IS:3764 & POWERGRID approved drawings/specification	Contractor	Approval by POWERGRID	C
B.	EXCAVATION					
i)	Dimensional conformity	Each location	IS:4091, IS:3764 & POWERGRID approved drawings/specification	Contractor	Approval by POWERGRID (JMC/MB)	B
ii)	Verticality/slopes & Squareness of each pit	Each location	IS:4091, IS:3764 & POWERGRID approved drawings/specification	Contractor	Checklist to be prepared and signed jointly	B
iii)	Verification of classification of foundation wherever applicable	Each location	IS:4091, IS:3764 & POWERGRID approved drawings/specification	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
C.	FOUNDATION BOLTS/METALLIC INSERTS					
i)	Check for proper	100%	POWERGRID	Contractor	Checklist to be	C

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	identification foundation bolts w.r.t type of foundation		specification & approved drgs.		prepared and signed jointly	
ii)	Visual check for mechanical damage and galvanising/ painting if applicable for metallic insert	100%	POWERGRID specification & approved drgs.	Contractor	Checklist to be prepared and signed jointly	C
iii)	Alignment & Level	100%	POWERGRID specification & approved drgs.	Contractor	Checklist to be prepared and signed jointly	B
iv)	Grouting/Underpinning of foundation base plate	100%	POWERGRID specification & approved drgs.	Contractor	Checklist to be prepared and signed jointly	C
D.	P.C.C. Padding	For all locations	IS:456 and POWERGRID approved foundation drawings & specification	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
E.	SHUTTERING(Form work)					
i)	Check for materials, breakage or damage	100%	IS:456, POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
ii)	Check for plumb, alignment parallelism, squareness and equidistance from stub	100% casting	IS:456, POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
iii)	Dimensional check	100% before casting	IS:456, POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
iv)	Check for level & height	100% before casting	POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
v)	Check for rigidity of	100%	POWERGRID	Joint	Approval by	B

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	frame/tightness		specification/ approved drawings	inspection by POWER GRID and contractor	POWERGRID	
vi)	Cleaning and oiling	100%	POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
vii)	Diagonal bracing if required as per drawings/site conditions	100%	POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
viii)	Checking of joints to avoid undue loss of cement slurry	100%	POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
E.	PLACEMENT OF REINFORCEMENT STEEL					
i)	Check the steel bars for rust, cracks, surface flaws, laminates etc. (Visual check)	100%	IS:456 and POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
ii)	Check as per the bar bending schedule before placement of concrete	For all locations	IS:456,IS:2502 and POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID (Pour Card)	B
iii)	Check cutting tolerance for bars as per check list/drawings. Check whether all the bent bars and lap lengths are as per approved bar bending schedule	For all locations	IS:456,IS:2502 and POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID (Pour Card)	B
iv)	Check whether all joints & crossing of bars are tied properly	100%	IS:456 and POWERGRID specification/	Joint inspection by POWER	Approval by POWERGRID	C

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	with right guage & annealed wire as per specification		approved drawings	GRID and contractor		
v)	Check for proper cover distance spacing of bars, spacers, & chairs after the reinforcement cage has been put inside the formwork	100%	IS:456 and POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
vi)	Check whether lapping of bars are tied properly with right gauge and annealed wire as per specification	100%	IS:456 and POWERGRID specification/ approved drawings	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	B
G.	PILE FOUNDATION (Additional Tests)					
i)	Check of centre line of pile group	Each pile group	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Checklist to be prepared and signed jointly	B
ii)	Check pile location	Each pile	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Checklist to be prepared and signed jointly	B
iii)	Temporary casing tube & permanent liner also check thickness of liner material (if applicable)	Each pile	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Verticality of the tube to be checked	B
iv)	Bentonite slurry (if applicable)	Each pile	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Records to be kept by POWERGRID for specific gravity of slurry	B
v)	Pile depth, level, size	Each pile	IS:2911 &	Joint	Approved by	B

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	and alignment		POWERGRID approved pile foundation drawings/specification	inspection by POWER GRID and contractor	POWERGRID	
vi)	Chipping of pile head	Each pile	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Before concreting pile cap, pile head to be chipped off for concreting	B
vii)	Standard Penetrator Test	As per Powergrid BOQ/Specification	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Records to be kept by POWERGRID	B
viii)	Pile load testing	As per Powergrid BOQ/Specification IS:2911	IS:2911 & POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Records to be kept by POWERGRID Approval by POWERGRID	B
ix)	Anchor bolts if applicable					
a)	Level, centre to centre distance of bolts	100% on each location	POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Checklist to be prepared and signed jointly	B
b)	Visual check for galvanising	100% on each location	POWERGRID approved pile foundation drawings/specification	Joint inspection by POWER GRID and contractor	Checklist to be prepared and signed jointly	B
3.	CONCRETING					
A)	APPROVAL OF MIX DESIGN	Each Mix.	IS:456 & POWERGRID approved drawings and specifications	POWER GRID Approved by lab	Approval by POWERGRID	A
B)	BATCHING,MIX-	100%	IS:456 &	Joint	Approval by	B

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	ING & PLACING OF CONCRETE AND COMPACTING		POWERGRID approved drawings and specifications	inspection by POWER GRID and contractor	POWERGRID	
C)	FIXING OF CHIMNEY COLUMN Check for Width/length squareness, parallelism & equidistance from stub	100%	IS:456 & POWERGRID approved drawings and specifications	Joint inspection by POWER GRID and contractor	Approval by POWERGRID	C
D)	PLACING CONCRETE, AND COMPACTING	100%	IS:456 & POWERGRID approved drawings and specifications	Joint inspection by POWER GRID and contractor	Min. gap between boxes and reinforcement bars should be maintained Approval by POWERGRID	B
E)	CONCRETE TESTING					
i)	Slump test	One sample per foundation	IS:456,IS:516, IS:1199 and POWERGRID Specification	Contractor	Approval by POWERGRID	B
ii)	Check for quantities for cement, fine aggregate, coarse aggregate and water while batching	100% on all locations	IS:456,IS:516, IS:1199 and POWERGRID Specification	Contractor	Checklist to be prepared and signed jointly	B

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Sl. No.	Component/Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	Check
F)	CONCRETE CUBE TESTING					
i)	Compressive Strength	One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength).	IS:1199,IS:456, IS:516 and POWERGRID Specification	POWERGRID Approved lab	Approval by POWERGRID Cubes must be tested within a week after 28 days curing period and test results should be approved.	A
G)	CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL	100%	IS:456,IS:516, IS:1199 and POWERGRID Specification	Contractor	Approval by POWERGRID	B
4.	BACKFILLING					
i)	Check for thickness of Layer & watering	100%	POWERGRID Specification and approved drawings	Contractor	Approval by POWERGRID	C
ii)	Visual check for correction/ramming	100%	POWERGRID Specification and approved drawings	Contractor	Approval by POWERGRID	C
iii)	Compaction test (Percentage of max. dry density)	Gantry Foundation-2 samples for each pit. Equipment	POWERGRID specification	POWERGRID approved lab	Review of lab test results by POWERGRID Elevation for testing to be	B

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		and other foundation-20% at random			decided by POWERGRID	
5.	BRICK-WORK					
i)	Mortar mix/proportion	Random	IS:2250, POWERGRID Specification & CPWD Specification	Contractor	Approval by POWERGRID	B
ii)	Plumb & Alignment	Random	POWERGRID Specification & CPWD Specification	Contractor	Approval by POWERGRID	B
iii)	Joints	Random	POWERGRID Specification & CPWD Specification	Contractor	Approval by POWERGRID	B
6.	PLASTERING					
i)	Plastering thickness and evenness	Random	POWERGRID Specification & CPWD Specification	Contractor	Approval by POWERGRID	B
ii)	Mortar mix proportion	Random	POWERGRID Specification & CPWD Specification	Contractor	Approval by POWERGRID	B
7.	CURING FOR CONCRETE, MASONRY, PLASTERING ETC.	100% on all location	IS:5613 & POWERGRID Specification	Contractor	Approval by POWERGRID	C
8.	SWITCH YARD EARTHING					
i)	Check for dimension of earth mat rod	Random	POWERGRID Specification & drawings	Contractor	Approval by POWERGRID	B
ii)	Depth of excavation	Random	POWERGRID Specification & drawings	Contractor	Approval by POWERGRID	C
iii)	Check for weld joints and anti corrosive treatment	Random	POWERGRID Specification & drawings	Contractor	Approval by POWERGRID	B
iv)	Backfilling	100%	POWERGRID Specification & drawings	Contractor	Approval by POWERGRID	C
9.	SITE SURFACING					
i)	Levelling	100%	POWERGRID Specification and approved drawings	Contractor	Checklist to be prepared and signed jointly	C

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ii) a)	Soil Sterilisation Spraying of chemicals	100%	POWERGRID Specification and Manufacturers recommendations	Con tractor	Checklist to be prepared and signed jointly	B
iii)	Grading of 20/40mm Stone	1 sample per lot of 500 Cubic Metre or part thereof from each source for each size	IS: 383, IS: 2386 and POWERGRID Specification. The grading shall be as per single sized nominal size	Contractor/ POWERGRID Approved lab	Each source to be approved by POWERGRID Review and acceptance of test results by POWERGRID	B
iv)	Compacted thickness of 20/40 mm stone layers as applicable	Random	POWERGRID Specification and specification drawings	Contractor	Checklist to be prepared and signed jointly	B

Section: GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A,B & C including accepting and deviation dispositioning authorities are indicated at Annexure-I.
2. POWERGRID specification shall mean POWERGRID technical specification, approved drawings data sheets and LOA provisions applicable for the specific contract.
3. Acceptance criteria and permissible limits for certain tests are indicated at Annexure-II. For balance tests, site to verify the same with respect to POWERGRID specification, relevant Indian Standards and/or prevalent code of practice.
4. It is clarified that the tests indicated at column 2 of this FQP i.e. against column “Component operation & Description of Test”, are only generally required to be conducted. However, POWERGRID reserves the right to carry-out any additional tests at any stage if the situation so warrants.
5. POWERGRID site representative shall witness all the tests conducted by the contractor as mentioned in the FQP. However, in case of tests conducted in the POWERGRID approved lab, it is preferred to witness the tests in the lab itself, if possible.
6. Head of GHQ shall approve testing laboratory before accepting the test results from the lab.
7. Head of GHQ shall approve the sources for cement , coarse aggregate, fine aggregate & water before actual utilization.
8. All the testing & measuring equipments used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by POWERGRID as records.
9. Classification of foundations shall be approved by POWERGRID based on the Joint Inspection Report & soil investigation reports.
10. Curing of concrete work should be continued for minimum period of 10 days.

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11. ZONE-IV FINE AGGREGATE

11.1 Zone-IV fine aggregate shall be used for nominal mix. Reinforced cement concreting work.

11.2 Zone-IV fine aggregate shall be avoided for design mix reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed with the prior approval POWERGRID site.

12. Bricks should be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

13. CEMENT

13.1 In case of cement is in the scope of the contractor, the same shall be procured from sources approved by POWERGRID site and got tested on sample basis for specified acceptance tests as specified in the FQP at a reputed Third Party Lab approved by POWERGRID site.

13.2 The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling. If the cement remains in store for a period of more than six months. All the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS

14.1 In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashtriya Ispat Nigam or the rerollers approved by main producers. The steel shall be got tested at site on sample basis for specified acceptance tests as specified in this FQP at a reputed Third Party Lab approved by POWERGRID site.

14.2 The results of the testing of cement and reinforcement steel referred in 13.1 and 14.1 above shall be got approved from POWERGRID site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. POWERGRID site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of POWERGRID site before starting the welding work.

16. Approval/acceptance of individual test results by POWERGRID in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc. arise due to site conditions, the specific approval of POWERGRID may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the contractor in a manner affording convenient access for identifications and inspection at all times. Storage of material shall be in accordance with IS: 4032 (Latest Edition).

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ANNEXURE-I

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ACCEPTING AND DEVIATION DISPOSITIONG AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLANT

CATE GORY	TYPE OF CHECK	100% CHECKING/WITNESSING BY	COUNTER CHECK/SURVEI LLANCE CHECK BY	ACCEPTING AUTHORITY, IF TEST RESULTS ARE WITHIN PERMISSIBLE LIMITS	DEVIATION DISPOSITIONING AUTHORITY
'A'	CRITI- CAL	EXECUTING DEPTT. PLUS FQA REPRESN-TATIVE GHQ	FQA REPRESN TATIVE AND RHQ/DHQ REPRESN TATIVE	HEAD OF DHQ	HEAD OF RHQ IN CONSULTATION WITH CQA, IF REQUIRED.
'B'	MAJOR	EXECUTING DEPTT.	DHQ- REPRESENTATI VE	HEAD OF GHQ	HEAD OF DHQ
'C'	MINOR	CONTRACTORS REPRESENTATIVE	EXECUTING DEPTT.	MINIMUM E4 LEVEL EXECUTING OF SUB- STATION/TL	HEAD OF GHQ

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ANNEXURE-2

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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS AND CONCRETE

A) CEMENT

S. No.	Description of the tests	33 Grade OPC as per IS:269	43 Grade cement as per IS:8112	PPC as per IS:1489	Low Heat cement
1.	Fineness (min.)	225 m ² /kg	225 m ² /kg	300 m ² /kg	225 m ² /kg
2.	Compressive strength (min.) 72 ± 1 hours 168 ± 2 hours 672 ± 4 hours	160 kgf/cm ² 220 kgf/cm ² -	23 MPa 33 MPa 43 MPa	16 MPa 22 MPa 33 MPa	100 Kgf/cm ² 160 Kgf/cm ² 350 Kgf/cm ²
3.	Initial setting time (min.)	30 minutes	30 minutes.	30 minutes	30 minutes
4.	Final setting time (max.)	600 minutes	600 minutes	600 minutes.	600 minutes.
5.	Soundness (Le Chatelier Method)	Maximum 10 mm expansion	Maximum 10 mm expansion	Maximum 10 mm expansion	Maximum 10 mm expansion
6.	Heat of Hydration (max.)	-	-	-	Max. 65 cal/gm for 7 days & max. 75 cal./gm for 28 days
7.	Chemical composition	As per IS	As per IS	As per IS	As per IS

B) COARSE AGGREGATE :

(i) Sieve Analysis

IS SIEVE DESIGNATION	PERCENTAGE PASSING FOR GRADED AGGREGATE OF NOMINAL SIZE		PERCENTAGE PASSING FOR SINGLE SIZED AGGREGATE OF NOMINAL SIZE	
	40 mm	20 mm	40 mm	20 mm
63 mm	-	-	100	-
40 mm	95 to 100	100	85 – 100	100
20 mm	30 to 70	95 to 100	0 – 20	85 - 100
10 mm	10 to 35	25 to 55	0 – 5	0 - 20
4.75 mm	0 to 5	0 to 10	-	0 - 5

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- (ii) Flakiness Index Not to exceed 25%
- (iii) Crushing value Not to exceed 45%
- (iv) Soundness of aggregate applicable for concrete works subject to frost action Loss of weight after 5 cycle not to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate
- (v) Deleterious material Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part – II (1963)

(C) FINE AGGREGATE

- (i) Sieve Analysis Shall confirm to Zone-I, Zone-II or Zone-III

IS Sieve designation	Grading Zone-I	Percentage Grading Zone-II	Passing for Grading Zone-III	Grading Zone-IV
10 mm	100	100	100	100
4.75 mm	90 - 100	90 - 100	90 - 100	90 - 100
2.36 mm	60 - 95	75 - 100	85 - 100	95 - 100
1.18 mm	30 - 70	55 - 90	75 - 100	90 - 100
600 Micron	15 - 34	35 - 59	60 - 79	80 - 100
300 Micron	15 - 20	8 - 30	12 - 40	15 - 50
150 Micron	0 - 10	0 - 10	0 - 10	0 - 15

- (ii) For guidance of adjusting sand in mix of concrete, the following table may be used.

Moisture Content %	building % by volume
2	15
3	20
4	25
5	30

- (iii) Silt Content Test: Shall not exceed 8% when tested as per test procedure specified in appendix-D of chapter 3 of 1991-92 CPWD Specification.
- (iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

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(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for 1:1½:3 (cement : sand : coarse aggregate) concrete shall be 265 kg/cm² for 28 days and for 1:2:4 nominal mix, it shall be 210Kg/cm².

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE

- (a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.
- (b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.
- (c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.
- (d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-Charge.
- (e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contract. If, however, the Engineer-in-Charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS:456.

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(H) SAMPLING PLAN FOR BRICK WORK

- i) Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

No. of bricks in the lot	For characteristics specified for individual bricks		For dimensional characteristics for group of 20 bricks-No. of bricks to be selected
	No. of bricks to be selected	Permissible no. of defective in the sample	
(1)	(2)	(3)	(4)
2001-10000	20	1	40
10001-35000	32	2	60
35001-50000	50	3	80

Note : In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

- ii) Scale of sampling for physical characteristics

Lot size	Sampling size for compressive strength water absorption and efflorescence	Permissible no of defectives for efflorescence
(1)	(2)	(3)
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

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(I) ACCEPTANCE CRITERIA FOR BRICK-WORK

- (i) Dimensional tolerances: The dimensions of modular bricks when tested shall be within the following limits per 20 bricks.

Length 372 to 388 cm (380 ± 8 cm)

Width 176 to 184 cm ($180 \pm$ cm)

Height 176 to 184 cm (180 ± 4 cm) for 90 mm high bricks

- (ii) In case of non-modular bricks, %age tolerance will be $\pm 2\%$ for group of 20 numbers of class 10 bricks and $\pm 4\%$ for other class of bricks.

- (iii) Compressive strength: The bricks, shall have a minimum average compressive strength as specified in POWERGRID specification. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified for the purpose of calculating the average compressive strength.

- (iv) Water absorption: The average water absorption of bricks shall not be more than 20% by weight.

- (v) Efflorescence: The rating of efflorescence of bricks shall not be more than moderate.