Subject: Corrigendum to SFQP of Transmission line Doc No: C/ FQA/SFQP/TL/030 (Rev.-08) Dtd. 10.07.2024

S. No.	Description of Activity	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by POWERGRID	Accepting authority in POWERGRID
				Agency	Extent		
SFQP Cl. 6(B) Page no. (6,7 of 32) [Existing Clause]							
6.	B) Foundation Classification	1. Visual observation of soil strata 2. Ground water level 3. History of water table in adj. Area/surface water 4. Soil Investigation wherever required	POWERGRID Specification	Contractor	100% at Field	100% at Field	a. [other than b & c locations below] Recommendation by Site Engineer to be approved by Site in-charge after visiting at least 10% locations. b. In case of WBC/SFR/FS / ULE / **Raised Chimney** based on recommendation by Site In-charge, to be approved by Sr DGM/GM/Sr GM after visiting at least 5% locations. ****Project In-charge (Sr GM/Chief GM) shall visit at least 2% locations for Test Check. c. For Spl. Fdns. (shallow depth, pile foundation, well foundation etc.) Acceptance by Regional head based on

							recommendation from Project in charge.
SFQP Cl. 6(B) Page no. (6,7 of 32) [Revised Clause]							
6.	B) Foundation Classification	1. Visual observation of soil strata 2. Ground water level 3. History of water table in adj. Area/surface water 4. Soil Investigation wherever required	POWERGRID Specification	Contractor	100% at Field	100% at Field	a. [other than b & c locations below] Recommendation by site engineer to be approved by Site In-charge after visiting at least 10% locations. b. In case of WBC/SFR/FS/ULE based on recommendation by site in-charge to be approved by Sr DGM/GM/Sr GM after visiting at least 5% locations. ****Project In-charge (Sr GM/Chief GM) shall visit at least 2% locations for test check. c. For Spl. Fdns. (Shallow depth, pile foundation, well foundation, **Raised Chimney** etc.) Acceptance by regional head **in consultation with corporate engineering.**

SFQP Cl. 8.3 Page No. 13 of 32 [Existing Clause]							
8.	3. Tower footing resistance (TFR) & Impedance	**TFR at locations before and after earthing.**	POWERGRID Specification	Contractor	100% at Field	20% locations to be verified	Site In-charge
SFQP Cl. 8.3 Page No. 13 of 32 [Revised Clause]							
8.	3. Tower footing resistance (TFR) & Impedance	**TFR & TFI as mentioned in the technical specification at locations before and after earthing.**	POWERGRID Specification	Contractor	100% at Field	20% locations to be verified	Site In-charge

General Notes Point No. 17 [Existing Clause]	
General Notes Point No. 17 Page 27 of 32 (Existing Clause)	Standard marking of ISI mark along with license number **(Seven-digit no., represented as CM/ L----)** should be verified for construction materials and test certificate submitted for review.
General Notes Point No. 17 [Revised Clause]	
General Notes Point No. 17 Page 27 of 32 (Revised Clause)	Standard marking of ISI mark along with license number **(represented as CM/ L----) wherever applicable** should be verified for construction materials and test certificate submitted for review.

Corporate Field Quality Assurance * Power Grid Gurgaon *

Ankit
21/11/25
Engineer (Field Quality Assurance)
Power Grid Corporation of India Ltd.
Plot No.-2, Sector-29, Gurgaon- 122 001 (Haryana)

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Item	Transmission Line
Applicability	POWERGRID Projects
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1.	Preliminary /Detailed Survey a) Route alignment	Optimization of route length	a. Preliminary survey. b. Topographical / Digitized maps. c. Tower spotting data given by Engg.	Contractor	100% at Field	100% based on records/documents.	Project In-charge in consultation with Regional Engineering
	b) Route profiling & tower spotting.	1. Ground clearance.	a. PLS CADD/Sag template b. Tower Spotting data c. Route alignment	Contractor	100% at Field	100% based on ref. documents.	Site In-charge
		2. Cold wt. Span		-do-	-do-	-do-	-do-
		3. Hot wt. Span		-do-	-do-	-do-	-do-
		4. Sum of Adj. Span (wind span)		-do-	-do-	-do-	-do-
		5. Angle of Deviation.		-do-	-do-	-do-	-do-
		6. Suitability of Tower spotting in hilly area		-do-	-do-	Verification of 100% at Field	-do-
2.	Check Survey Tower Location & Final Length	i) Route alignment ii) Final Length. (Span/Section) iii) Angel of deviation & pit marking	a. Route alignment b. Tower Schedule c. Profile	Contractor -do-	100% at Field -do-	i) All angle towers in plains and 50% in hilly terrains. ii) Final length to be checked on 100% basis based on records/documents. iii) 20 % test check at site for physical verification.	Site Engineer

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3.	Detailed Soil Investigation a) Bore log	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per POWERGRID Specification	Contractor (Soil testing agency approved by POWERGRID)	100% at Field	To witness 20% at Field by site engineer	Site in Charge
	b) Tests on samples	As per tech. Specs.	As per POWERGRID Specification	Contractor (Testing in Laboratory of soil testing agency approved by POWERGRID)	1.100% by testing lab (Reports to be signed by Testing agency person. 2. Recommendation part of soil testing report to be signed by contractor 3. Jointly signed field data should be attached with the report.	Review of soil testing report by POWERGRID	Site In-charge based on the guideline issued by CC Engg. as per Annexure-6
	c) Special foundations	As per tech. Specs	As per POWERGRID Specification	Contractor (Testing in Laboratory of soil testing agency approved by POWERGRID)	100% by testing lab (Reports to be signed by Testing person & Checking person)	Review of soil testing report by POWERGRID	Site In-charge based on the guideline issued by CC Engg as per Annexure-6
4	Revetment RR Masonry	a) Size of Stone	CPWD Specification.	Contractor	100% physical verification	Physical verification on random basis	Site Engineer
		b) Cement : Sand ratio in mortar	As per POWERGRID Specification	Contractor	100%	Physical verification in random	-Do-
5	Benching Checking of Reduced Level	1. Reduced Level 2. Contour map with detailed Calculation	As per approved drawings	Contractor	100%	100% by Site Engineer and 20% by Line In-charge	Site In-charge
6.	Tower Foundation						
	A) Materials 1.Cement	1. Brand approval	Cement of approved brands according to the COV in POWERGRID web	Contractor	100%	Any new brand cement proposed by Contractor shall be assessed by	FQA-RHQ

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			site may be procured and validity of BIS license to be ensured.			RHQ-FQA and approved by Regional Head with BIS License, validity. After approval, details shall be forwarded to CC-FQA for uploading in COV.	
		2. Physical tests	As per document at Annexure-I of this FQP	Contractor Samples to be taken jointly with POWERGRID and tested at POWERGRID approved lab	(i) No testing is required in case of cement procured directly from the main producer/manufacturer/ authorized dealer with traceability and if cement (in good condition without setting) is used within three (3) months from the manufacturing date based on MTC. MTC shall be reviewed. (ii) Testing (Physical & Chemical) shall be done in case storage of cement is more than three (3) months from the manufacturing date.	100% review of lab test results and MTC. Test results shall be sent by the Lab. by E-mail directly to POWERGRID; further, hard copy of test certificate shall also be sent by the Lab directly to POWERGRID by postal Address.	Site In-charge
		3. Chemical Tests: Chemical composition of Cement	-do-	Contractor to submit MTC	Review of all MTC's	100% review of MTC test results	Site In-charge
	2. **Reinforcement Steel**	1. Source approval	May be procured either from producers directly or	Contractor	As proposed by contractor.	Material shall be supplied from Producers /	Site In-charge



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				Agency	Extent		
			through the authorized dealers who can produce MTC from producers with traceability. Refer COV in POWERGRID web site for list of **producers** of reinforcement steel and validity of BIS license to be ensured. Also refer approved list of Cut & Bend suppliers			authorized dealers.	
	2.Physical and Chemical analysis test		As per Annexure-2 of this FQP	Contractor to submit MTC	i) No testing is required for steel procured directly from POWERGRID pre-approved producers as per COV under CAT-I or their notified authorized dealers with full traceability (only MTC shall be reviewed) as no failure in physical and chemical testing observed in last decade by POWERGRID. (CAT-I: Approved Vendor List in COV) ii) For other vendors under CAT-II or their notified dealers / new vendors, frequency testing of	100% review of MTC. 1) Review of Lab test results. Test results shall be sent by the Lab. by E-mail directly to POWERGRID; further, hard copy of test certificate shall also be sent by the Lab. directly to POWERGRID by postal Address. 2) Unit weight of three samples to be witnessed.# #	Site In-charge Site Engineer

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					Reinforcement steel is to be done at regular intervals as per the existing SFQP i.e. One sample/ 300MT / Manufacturer shall be jointly sealed by POWERGRID and tested at POWERGRID approved Lab. Based on the supply, experience and performance up to one-year, further decision on exemption of testing for these vendors shall be taken by FQA dept. (CAT-II: New Vendors listed in COV/ New Vendors).		
		Note:- In case of steel vendors under CAT-II or their notified dealers / new vendors, i) All sizes of 10 mm and above shall be taken for testing in every 300 MT. ii) ## Three samples of each size of Reinforcement steel (all sizes of 10mm & above) out of 100MT steel Lot need to be physically weight at site in presence of POWERGRID to ascertain their acceptance as per technical specification. The weighted samples at site may be kept under custody for three months for further examination by any auditing authority (if required).					
	3.Coarse Aggregates	1. Source approval	Source with materials meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of Joint samples tested at POWERGRID approved Lab.	To review the proposal based on the documents	Site In-charge Once approved, the quarry shall be used for all the running contracts under various packages.
		2. Physical tests	As per document at Annexure-3 of this FQP	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per **1000** cum or part thereof per source for 765KV & above TL and One sample per **500** cum or part thereof per source for 500KV & below TL, Samples to be tested by Contractor in POWERGRID approved lab	100% review of lab test results.	Site In charge.

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	4.Fine aggregate	1. Source approval	Source with materials meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the results of Joint samples tested in POWERGRID approved lab.	To review the proposal based on the documents.	Site In-charge Once approved, the particular quarry shall be used for all the running contracts under various packages.
		2. Physical test	As per Annexure-4 of this FQP	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per **1000** cum or part thereof per source for 765KV & above TL and One sample per **500** cum or part thereof per source for 500KV & below TL, Samples to be tested by Contractor in POWERGRID approved lab	100% review of lab test results.	Site In charge.
	5. Water	1. Cleanliness (Water shall be fresh and clean)	POWERGRID Specification	Contractor	100% visual check at Field	Verification at random	Site Engineer
		2. Ph Value	- do -	Contractor at site with calibrated Ph meter or any other approved method	One sample per source	100% review of the field test results Ph not less than 6	Site Engineer
	B) Foundation Classification	1. Visual observation of soil strata 2. Ground water level 3. History of water table in adj. Area/surface water 4. Soil Investigation wherever required	POWERGRID Specification	Contractor	100% at Field	100% at Field	a. [other than b & c locations below] Recommendation by Site Engineer to be approved by Site in-charge after visiting at least 10% locations. b. In case of WBC/SFR/FS / ULE / Raised Chimney based on

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							recommendation by Site In-charge, to be approved by Sr DGM/GM/Sr GM after visiting at least 5% locations. ****Project In-charge (Sr GM/Chief GM) shall visit at least 2% locations for Test Check. c. For Spl. Fdns. (shallow depth, pile foundation, well foundation etc.) Acceptance by Regional head based on recommendation from Project in charge.
	C) Concrete Works a) Before concreting						
	1. Bottom of excavated pit	Pit dimensions	Construction Drgs.	Contractor	100% at Field	100% check by POWERGRID	Site Engineer
	2.P.C.C Grade, thickness & Size	Completeness	IS 456 (Latest Revision)/ POWERGRID approved construction drawings & specification.	Joint Inspection by POWERGRID and CONTRACTOR	For all locations	For all locations	Site Engineer

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	3. Stub setting	1) Centre Line	Construction Drgs.	-do-	-do-	-do-	-do-
		2) Diagonals and back to back	-do-	-do-	-do-	-do-	-do-
		3) Level of stubs	-do-	-do-	-do-	-do-	-do-
	4. Frustum box quality and measurements	Dimensions	-do-	-do-	-do-	-do-	-do-
	5. Reinforcement steel	Placement	Bar bending schedule.	Contractor	100%	Checking of record 100% and physical verification in Random	At least 5% locations shall be cross verified by Site In-charge, at random with respect to stub setting and reinforcement steel placement.
	6. Use of Steel Jointing Coupler	In addition to present TS Provisions, Reinforcement couplers for mechanical splices of bars in concrete may be used as per IS 16172: 2023	IS 16172: 2023	-do-	-do-	-do-	-do-
	7. Rod Type Earthing	Dia. and length of the rod.	POWERGRID specification and approved construction drawings. Photograph of GPS enabled camera	-do-	-do-	-do-	-do-
	8. Concrete mix proportion (Applicable for Design Mix)	Ratio of mix proportion	Approval of Design Mix submitted by contractor based on inputs furnished by POWERGRID as per Annexure- 7 of	Contractor	100%	100%	Site In charge in consultation with Regional engineering department.

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			this FQP.				
	b) During concreting 1. Workability	Slump test as per IS 1199 (Latest Revision)	Range 25 mm to 75 mm refer document at Annexure-5 of this FQP	Contractor	Minimum Two per day per location, preferably one at the start of concreting	check at random	Site Engineer
	2. Use of admixtures in concreting both in nominal and design mix	To achieve workability as per site by slump test	Admixtures in concreting both in nominal and design mix may be used as per IS 9103 to achieve workability as per site requirements, with approval of Engineers in Charge.	Contractor	Use as per IS 9103:1999 (Reaffirmed 2018) to achieve workability.	check at random	Site Engineer
	3. Concrete Strength	Cubes Comp Strength	As per POWERGRID Specifications & as per Annexure-5 of this SFQP	Contractor Casting of cubes at site. Cubes to be tested for 28 days strength at /POWERGRID Lab/At site (if testing machine installed by contractor is duly calibrated by NABL Lab.)/POWERGRID approved Lab. Cubes at 100% location are to be taken in presence of POWERGRID officials. Cubes molds should be of ISI marked.	**Nominal Mix** One sample of 3 cubes in each tower locations if all the legs are cast continuously without interruption. If otherwise, additional 3 cubes to be taken for every subsequent continuous casting case. It is to be ensured that in every case 3 cubes shall be selected in such a way that one each from start, middle and end of the casting process.	Normally testing shall be carried out at the POWERGRID in-house cube testing facility. Alternatively, samples shall be tested at cube testing facility installed by contractor at POWERGRID premises, in the witness of POWERGRID.	Site Engineer. All cubes shall be tested at In-house testing facilities. However, in case of breakdown of CTM or other force majeure conditions, cubes may be tested at approved TPL. Out of testing on 10% samples to be witnessed at TPL by POWERGRID Site Engineer and at least

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						Lastly, POWERGRID approved Labs, in this case, test results shall be sent by the Lab, by E-mail directly to POWERGRID; further, hard copy of Test Certificate shall also be sent by the Lab directly to POWERGRID by Postal Address. **NOTE: The efforts shall be made to carry out 100% cube testing in the in-house cube testing facility.**	5% samples at random, shall be witnessed by Site In-charge. In-case of Site/ POWERGRID Lab, 100% witness by POWERGRID Representative
			IS 456 (Latest Revision)		**Design Mix** One sample of 3 cubes in each tower locations if all the legs are cast continuously. If otherwise, additional 3 cubes to be taken for every subsequent continuous casting case. Concrete Cube collection & testing in case of RMC: Ready Mix Concrete (RMC)	Further, POWERGRID to witness testing on 20% samples and also to review 100 & test results.	Site Engineer

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					may be allowed and testing/acceptance documentation to be maintained shall be as per as per IS: 4926:2003 (Reaffirmed 2022). Concrete cube sampling should be done at site. However, in case cube samples cannot be taken at site, taking of cube samples at RMC is acceptable. Concrete composition and batch record for each and every lot shall be maintained as per IS 4926 4926:2003 (Reaffirmed 2022). The raw material in the RMC bins must be from approved sources/ brands make.		
	2.Use of PVC Block in place of Concrete Cover Blocks:	PVC cover blocks may be used as an alternative to concrete cover blocks as per clause no.12.3.2 of IS 456	IS 456:2000 (Reaffirmed 2021)	Contractor	100 %	100 %	Site Engineer
	3.Anti-Corrosive paint on Stubs	Portion of Stubs/Towers to be painted	Technical Specification	Contractor	100% at Field	20% on random basis	Site Engineer
	c) After Concreting a) Water Curing, Back filling & leveling of filled up soil	Compliance & Completeness	As per Specification	Contractor	100%	100%	Site Engineer

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	b) Membrane Curing	In addition to the moist curing of casted concrete structures, membrane curing can also be used as per IS 456: 2000(Reaffirmed 2021). Cl. no. 13.5.2	IS 456:2000 (Reaffirmed 2021) and as per Specification/manufacturer's catalogue	Contractor	100%	100%	Site Engineer
	c) Back-to-back, level and diagonals to be checked by Total Station and recorded in JMC	Dimension Check	As per Technical Specifications & approved drawings	Contractor	100% at Field	Random check & 100% verification of records	Site Engineer
	d) Application of Bituminous paint on foundation (wherever applicable)	Visual check and quantity of application	As per Technical Specifications & approved drawings	Contractor	100% at Field	Random check & 100% verification of records	Site Engineer
	NDT/Core Tests	**UPV and Rebound Hammer test /Core test**	**Refer POWERGRID's Standard procedure for Testing/Assessment of compressive strength of casted Concrete Revision-1 as per Annexure-8 of SFQP.** **## Accepting Authority:** (i) For NDT/Core tests results, if not meeting the acceptance criteria, Regional Head is the Accepting Authority. (ii) CGM (Projects) will be the accepting authority for NDT (UPV & RHT) and core testing done on failed concrete cube test results or not meeting the acceptance criteria in a third party approved lab as per Standard procedure for Testing / Assessment of compressive strength concrete in casted foundations and test results are found satisfactory or meet the acceptance criteria laid down in IS Codes. A quarterly report in this regard will be submitted to Regional ED.				##
7.	Pile Foundations		**Refer FQP OF TRANSMISSION LINE PILE FOUNDATION**				
8.	Tower Erection 1. Materials of Tower member/bolts	Visual checking for 1. Stacking 2. Cleanliness	Approved Drawings/BOM	Contractor	100% at stores	100% verification of records	Site Engineer

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	& nuts/washers/accessories	3. Galvanizing 4. Damages					
	2. Erection of Super-Structure	1. Sequence of erection	As per Appd. Drgs./POWERGRID specification	Contractor	100% at field	Random	Site Engineer
		2. Check for completeness (Missing, hanging, bend etc.)	As per Appd. Drgs./POWERGRID specification	Contractor	100% at field	25% by Site Engr and random by Site Incharge.	Site In charge
		3. Tightening, Punching, Orientation, Correct size & missing nuts and bolts	As per Appd. Drgs./POWERGRID specification	Contractor	100% at field	25% by Site Engr and random by Site Incharge.	Site In charge
		4. Check for verticality.	-do-	-do-	-do-	-do-	-do-
		5. Tack welding & application of zinc rich paint for bolts & nuts.	POWERGRID Specification	Contractor	100% at Field	-do-	Site Engineer
	3. Tower footing resistance (TFR) & Impedance	TFR at locations before and after earthing.	POWERGRID Specification	Contractor	100% at Field	20% locations to be verified	Site In-charge
9	Earthing Pipe Type	Salt & charcoal	As per approved drawings	Contractor	%	Checking of record 100% and physical verification in Random	Site Engineer
	Counterpoise Type	Length & Depth of earth electrode.	As per approved drawings	Contractor	100%	---do---	Site Engineer
	Shield Wire Type	Length of shield Wire	As per approved drawings	Contractor	100%	---do---	Site Engineer
	Chemical pipe Type	• Resistivity test	As per approved	Contractor	100%	---do---	Site Engineer

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		using soil box. • Leaching test • Sulphur determination • Corrosion test	drawings				
10	Stringing 1. Materials						
	a) Insulators	1. Visual check for cleanliness/glazing/cracks/and white spots.	POWERGRID Specification	Contractor	100% at Field	100% verification of records and to carry Physical verification random checks on 10%	Site Engineer
		2. IR Value Only for Disc Insulators	Minimum acceptable value 2000 Mega ohm	-do-	Test shall be carried on 100% insulators using 5/10 kV (DC) Megger	100 % by Contractor and record review by POWERGRID and joint witnessing by POWERGRID on 05% insulator	Site In-charge
		3. Traceability (Make/batch No./Locations where installed)	Packing list/CIP	Contractor	100% at field (Details of CIPs has to be recorded in SIV/Delivery challan)	100% Review of records	Site Engineer
	b) Conductor	On receipt, 1. Visual check of drum.	Packing list/CIP	Contractor	100% at stores	20% check	Site Engineer
		2. Check for seals and POWERGRID signed sticker on outer end	-do-	-do-	-do-	-do-	-do-
		3. Check depth from top of flange to the top of the outer most layer	-do-	-do-	-do-	-do-	-do-
	c) Earth wire/ OPGW	Check for seals at both ends	Packing list/ CIP	Contractor	100% at stores In case of OPGW, OTDR test	20% check 20% joint	-do-

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					shall be carried on 100% OPGW before stringing	witnessing by POWERGRID	
	2. **Field activity**						
	a) Before Stringing	Readiness for stringing	Stringing procedures as per POWERGRID specification	Contractor	Readiness certificate to be submitted by the Contractor	Review of Certificate	Site In-charge
	b) During stringing	(Conductor/Earth-wire)					
		1. Scratch/cut check (Visual)	Appd. Drawings/ POWERGRID Specn.	Contractor	100% at Field	100% verification of record & 20% Field check	Site Engineer
		2. Repair sleeve	-do-	-do-	-do-	-do-	-do-
		3. Mid span /Dead end joints	-do-	-do-	-do-	-do-	-do-
		4. Guying	Appd. Guying arrangement/POWERGRID Specn.	-do-	-do-	100%	Site Engineer
	c) After stringing	Check for,					
		1. Sag/Tension	Stringing Chart / tower Spotting data	-do-	-do-	100% verification of record & 20% field check	Site Engineer
		2. Electrical clearances	As per Appd. Drgs./POWERGRID specifications	-do-	-do-	-do-	-do-
		i) Ground clearance	As per Appd. Drgs./POWERGRID Specification	Contractor	100% at Field	100% record & Field Check 20%	Site Engineer
		ii) Live metal clearance etc.	-do-	-do-	-do-	-do-	-do-
		3.Jumpering/ Jumper drop check	-do-	-do-	-do-	-do-	-do-
		4. Copper / Aluminum bond	As per Appd. Drgs./POWERGRI	Contractor	100% at Field	100% record & Field	Site Engineer

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S. No.	Description of Activity	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by POWERGRID	Accepting authority in POWERGRID
				Agency	Extent		
			D Specification			Check 20%	
		5a). Placement of spacer/damper	As per Specn./Drgs/ placement chart	-do-	-do-	-do-	-do-
		5b) Tightening of hardware bolts & nuts and fixing of split pins as per manufacturer recommendations.	-do -	-do-	100% with fixed torque wrench.	-do-	-do-
11.	Final Testing a) Pre-commissioning of lines	Readiness of lines for pre-commissioning					
		1. Completeness of line. 2. Meggar test of line	POWERGRID latest pre-commissioning procedures	Joint inspection by POWERGRID and Contractor	100%	100%	Site In-charge
	b) Commissioning of line	Readiness of lines for commissioning 1. Geo tagged photograph of each tower after completion of stringing, to ascertain the completeness of tower.	a) POWERGRID latest pre-commissioning procedures b) Pre-commissioning Report c) CEA clearance	Joint inspection by POWERGRID and Contractor	100%	100%	Site In-charge
	Storage of materials 1)Storage of Tower parts, Conductor drums, Insulators, Hardware fittings, Bolts/Nuts, RF Steel	Visual & Physical check	POWERGRID specifications	Contractor	100%	Random check	Site Engineer
	2) Cement Storage	Visual & Physical check	POWERGRID specifications	Contractor	100%	Random check	Site Engineer

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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT

ORDINARY PORTLAND CEMENT

S. No.	Name of the test	Ordinary Portland Cement 33 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Ordinary Portland Cement 43 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Ordinary Portland Cement 53 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Remarks
a)	**Physical tests**				To be conducted in POWERGRID approved Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 cm2 per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm2 per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm2 per gm.	Blaine's air permeability method as per IS 4031 (Part-2):1999, Reaffirmed 2018
(ii)	Compressive strength	72 ± 1 hour : Not less than 16 Mpa (16 N/mm2) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm2) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm2), Not more than 48Mpa (48N/mm2)	72 ± 1 hour : Not less than 23 Mpa (23 N/mm^2) 168 ± 2 hour : Not less than 33Mpa (33 N/mm^2) 672 ± 4 hour : Not less than 43 Mpa (43 N/mm^2), Not more than 58Mpa (58N/mm2)	72 ± 1 hour : Not less than 27Mpa (27 N/mm^2) 168 ± 1 hour : Not less than 37Mpa (37 N/mm^2) 672 ± 1 hour : Not less than 53 Mpa (53 N/mm^2)	As per IS 4031 (Part-6): 1988, Reaffirmed 2019
(iii)	Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	As per IS 4031 (Part-5): 1988, Reaffirmed 2019. -do-
(iv)	Soundness	Unaerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test.	Unaerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test	Unaerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test.	Le Chatlier and Autoclave test as per IS 4031 (Part-3): 1988, Reaffirmed 2019.



Annexure-1
(Sheet 02 of 03)

S. No.	Name of the test	Ordinary Portland Cement 33 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Ordinary Portland Cement 43 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Ordinary Portland Cement 53 grade *as per IS 269: 2015 (Reaffirmed 2020)*	Remarks
b)	**Chemical composition tests**				Review of MTC only
		a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02%	a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02%	a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.80 to 1.02%	
		b) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	
		c) Insoluble residue, percentage by mass Max. 5.00%	c) Insoluble residue, percentage by mass Max. 5.00%	c) Insoluble residue, percentage by mass Max. 5.00%	
		d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	
		e) Total sulphur content calculated as sulphuric anhydride (SO_3), percentage by mass not more than 3.5%.	e) Total sulphur content calculated as sulpuric anhydride (SO_3), percentage by mass not more than 3.5%.	e) Total sulphur content calculated as sulpuric anhydride (SO_3), percentage by mass not more than 3.5%.	
		f) Total loss on ignition shall not be more than 5 percent	f) Total loss on ignition shall not be more than 5 percent	f) Total loss on ignition shall not be more than 4 percent check	
		g) Chloride content, percent by mass, max 0.1%	g) Chloride content, percent by mass, max 0.1%	g) Chloride content, percent by mass, max 0.1%	

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Annexure-1
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S. No.	Name of the test			Remarks
2.	**PORTLAND POZZOLANA CEMENT AS PER IS 1489 (Part 1) Reaffirmed 2020**			
a)	**Physical tests**	i) Fineness	Specific surface area shall not be less than 300 sq.m. per Kg. or 3000 Cm^2 per gm.	To be conducted in POWERGRID approved Lab
		ii) Compressive strength	a) 72 ± 1 hour : Not less than 16 Mpa (16 N/mm^2) b) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm^2) c) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm^2)	
		iii) Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	
		iv) Soundness	Un aerated cement shall not have an expansion of more than 10mm Le chatlier test and 0.8% by Autoclave test as per IS 4031 (Part-3):1988 (Reaffirmed 2019)	
b)	**Chemical composition tests**			
		a) Magnesia percentage by mass Max. 6%		Review of MTC only
		b) Insoluble residue, percent by mass, (a) Maximum {x + 4 (100-x)/100} (b) Minimum 0.6x, where x is the declared % of fly ash in the given Portland pozzolana cement.		-do-
		c) Total sulphur content calculated as sulpuric anhydride (SO_3), percentage by mass not more than 3.5		-do-
		d) Total loss on ignition shall not be more than 5 percent		-do-
		e) Chloride content, percent by mass, max 0.1%		-do-



Annexure-2

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL

AS PER IS 1786 -2008 (Reaffirmed 2018)

S. No.	Name of the test	Fe 500	Fe 500D	Fe 550	Fe 550D
i)	**Chemical analysis test**				
	Carbon	**0.30 Percent Maximum**	**0.25 Percent Maximum**	**0.30 Percent Maximum**	**0.25 Percent Maximum**
	Sulphur	**0.055 Percent Maximum**	**0.040 Percent Maximum**	**0.055 Percent Maximum**	**0.040 Percent Maximum**
	Phosphorus	**0.055 Percent Maximum**	**0.040 Percent Maximum**	**0.055 Percent Maximum**	**0.040 Percent Maximum**
	Sulphur & Phosphorus	**0.105 Percent Maximum**	**0.075 Percent Maximum**	**0.10 Percent Maximum**	**0.075 Percent Maximum**
	Carbon Equivalent	**0.42 percent Maximum**	**0.50 percent Maximum**	**0.50 percent Maximum**	**0.61 percent Maximum**
ii)	**Physical tests**				
	a) Tensile Strength/Yield stress ratio,	≥1.08, but tensile strength not less than 545.0 N/mm^2	≥1.10, but tensile strength not less than 565.0 N/mm^2	≥1.06, but tensile strength not less than 585.0 N/mm^2	≥1.08, but tensile strength not less than 600.0 N/mm^2
	b) 0.2% of proof stress/Yield stress Minimum, N/mm ^{2}	500	500	550	550
	c) Elongation percent , Minimum	12	16	10	14.5
	d) Total elongation at maximum force, percent, Minimum	--	5	5	5
iii)	**Bend & Rebend tests**	Pass	Pass	Pass	Pass



Annexure-3

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383:2016 (Reaffirmed 2021)

3.	**Coarse Aggregates**										
i)	Physical Tests										
	a) Determination of particles size	a. IS Sieve Designation	**%age passing for Single-Sized Aggregate of nominal size**					**Percentage Passing for graded Aggregate of nominal size**			
			40 mm	**20 mm**	**16 mm**	**12.5 mm**	**10 mm**	**40 mm**	**20 mm**	**16 mm**	**12.5 mm**
		63 mm	100	-	-	-	-	-	-	-	-
		40 mm	85 to 100	100	-	-	-	90 to 100	100	-	-
		20 mm	0 to 20	85 to 100	100	-	-	30 to 70	90 to 100	100	100
		16 mm	-	-	85 to 100	100	-	-	-	90-100	-
		12.5 mm	-	-	-	85 to 100	100	-	-	-	90 to 100
		10 mm	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 55	30 to 70	40 to 85
		4.75 mm	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
		2.36 mm	-	-	-	-	0 to 5	-	-	-	-
	b. Combined Flakiness and Elongation index		Not to exceed 40%								
	c. Crushing Value		Not to exceed 30%								
	d. Presence of deleterious material		Total presence of deleterious materials not to exceed 5% for uncrushed, 2% for crushed and manufactured coarse aggregates as per Annexure- 3A.								
	e. Hardness		Abrasion value not more than 50%, Impact value not more than 45%								
	f. Soundness test (for concrete work subject to frost action)		Not to exceed 12% when tested with sodium sulphate and 18% when tested with magnesium sulphate								



Annexure-3A

Deleterious Substance	Percentage by Mass, Max		
	Uncrushed	Crushed	Manufactured
a) Coal and lignite	1.0	1.0	1.0
b) Clay lumps	1.0	1.0	1.0
c) Materials finer than 75 micron	1.0	1.0	1.0
d) Soft fragments	3.0	--	3.0
e) Shale	--	--	--
f) Total of percentages of all deleterious materials (except mica) including S. No. a) to e) for uncrushed and crushed aggregates	5.0	2.0	2.0



ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383:2016 (Reaffirmed 2021)

4.	**Fine aggregates**				
i)	Physical Tests	**IS Sieve Designation**	**Percentage passing for**		
	a) Determination of particle size		**F.A. Zone I**	**F.A. Zone II**	**F.A. Zone III**
		10 mm	100	100	100
		4.75 mm	90-100	90-100	90-100
		2.36 mm	60-95	75-100	85-100
		1.18 mm	30-70	55-90	75-100
		600 microns	15-34	35-59	60-79
		300 microns	5 to 20	8 to 30	12 to 40
		150 microns*	0-10	0-10	**0-10**
	b) Presence of deleterious material	Total presence of deleterious materials not to exceed 5% for uncrushed & 2% for crushed/Mixed and manufactured fine aggregates as per Annexure- 4A.			
	c) Soundness Applicable to concrete work subject to frost action	10% when tested with sodium sulphate and 15% when tested with magnesium sulphate			

***For crushed stone sand the permissible limit on 150 microns IS Sieve is increased to 20 %.**

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Annexure-4A

Deleterious Substance	Percentage by Mass, Max		
	Uncrushed	Crushed/Mixed	Manufactured
a) Coal and lignite	1.0	1.0	1.0
b) Clay lumps	1.0	1.0	1.0
c) Materials finer than 75 micron	3.0	15.0 (for crushed sand) 12.0 (for mixed sand)	10.0
d) Soft fragments	--	--	--
e) Shale	1.0	--	1.0
f) Total of percentages of all deleterious materials (except mica) including S. No. a) to e) for uncrushed aggregates and a) & b) for crushed/mixed and manufactured aggregates	5.0	2.0	2.0



Annexure-5

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CONCRETE WORK

1)	**Concrete**	a) Workability	Slump shall be recorded by slump cone method and it shall between 25-75 mm depending upon workability requirement as per IS 456:2000 (Reaffirmed 2021).
		b) Compressive strength	**For nominal (volumetric) concrete mixes compressive strength for 1:1.5:3 (Cement : Fine aggregates : Coarse aggregates) concrete 28 days strength shall be min 265Kg/cm^2 (26 N/mm2) and for 1:2:4 (Cement: Fine Aggregate: Coarse Aggregate) nominal mix concrete 28 days strength shall be min 210Kg/cm^2 (20.60 N/mm2)**

Notes:

1) **ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR NOMINAL MIX CONCRETE: As per clause 5.4.10.4 of CPWD Specifications, Volume 1**

(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 strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength up to 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.*

(e) In case cube strength is less than 70% of specified strength, then structure shall be rejected (to be dismantled and recast) and thus no payment shall be made.

If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of casted concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance / non-acceptance of concrete based on test results. Regional head shall take further decision on nonaccepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC -Engg. CC, Engg will review the strengthening proposal and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor. In case such structure is retained, part payment shall be paid as indicated in payment procedure in SOP.

* Corrected Content

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2) 53 Grade cement shall be used after obtaining specific approval of the Engineer in charge.
3) Portland slag cement conforming to IS 455:2015 (Reaffirmed 2020) may be used as per Technical Specification.
4) All Design Mix concrete shall be as per IS 456:2000 (Reaffirmed 2021)

5) **ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR DESIGN MIX CONCRETE: As per Table-11 of IS 456:2000 (Reaffirmed 2021) as given below:**

Table 11 Characteristic Compressive Strength Compliance Requirement
(Clauses 16.1 and 16.3)

Specified Grade	Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm²	Individual Test Results in N/mm²
	Min	*Min*
(1)	(2)	(3)
M 15 and above	$\geq f_{ck}$ + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm²) or f_{ck} + 3 N/mm², whichever is greater	$\geq f_{ck}$ - 3 N/mm²

NOTES

1 In the absence of established value of standard deviation, the values given in Table 8 may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

2 For concrete of quantity up to 30 m³ (where the number of samples to be taken is less than four as per the frequency of sampling given in **15.2.2**), the mean of test results of all such samples shall be f_{ck} + 4 N/mm², minimum and the requirement of minimum individual test results shall be f_{ck} – 2 N/mm², minimum. However, when the number of sample is only one as per **15.2.2**, the requirement shall be f_{ck} + 4 N/mm², minimum.

6. The test results of the cube samples shall be the average strength of the three specimens. The individual variation shall not be more than ± 15% of the average.

General Notes:

1) This standard Field Quality Plan is not to limit the supervisory checks which are otherwise required to be carried out during execution of work as per drawings/Technical specifications etc.
2) All materials under supply contract should have Cat-A CIP before they are erected.

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3) Contractor shall be responsible for implementing/documenting the SFQP. Documents shall be handed over by the contractor to POWERGRID after the completion of the work.
4) Project incharge means over all incharge of work. Site in-charge means in-charge of the line. Site engineer means in -charge of the section.
Site Engineer's responsibility may be allocated to Site JE, with the approval of Regional Head, only in such cases where, Site Engineer is not in position.
5) In case of deviation the approving authority will be one step above the officer designated for acceptance in this quality plan subject to minimum level of Line incharge.
6) Acceptance criteria and permissible limits for tests are indicated in the Annexures. However for further details/tests POWERGRID specification and latest relevant Indian standards shall be referred.
7) Tests as mentioned in this FQP shall generally be followed. However E.I.C. reserves the right to order additional tests wherever required necessary at the cost of the agency.
8) All counter checks/tests by POWERGRID shall be carried out by POWERGRID's officials' at least at the level of Site Engineer.
9) The authorized dealer of reinforcement steel means the dealer whose names are listed in the steel producer's web site or certified by the producers.
10) Accepting Authority for testing Laboratory shall be Regional Head.
11) READYMIX CONCRETE (RMC) IS ACCEPTABLE FOR USE. HOWEVER, SITE INCHARGE SHALL APPROVE THE SOURCE OF MATERIALS TO BE USED FOR RMC.

The documentation to be maintained shall be as per IS 4926:2003 (Reaffirmed 2022) i.e.
i) Information to be supplied by the purchaser (clause 7)
ii) Information to be supplied by the producer (clause 8)
iii) Sampling for concrete strength should be one set of 3 nos. of cubes for every 50 cum or part thereof for each day of concreting and 28 days compressive strength shall be tested in line with IS 456:2000 (Reaffirmed 2021).

12) The preference shall be given to batching/RMC plants approved by Quality Council of India.
13) Epoxy coating on reinforcement steel wherever required shall be done as per IS 13620:1993 (Reaffirmed 2020).
14) Cement is to be used in the order, it is delivered (i.e. First in First Out). In case the cement remains in storage for more than 3 months, the cement shall be retested before use and shall be rejected, if it fails to conform to any of the requirements given in the relevant Indian Standard. Cement shall be packed in bags and stored in accordance with the provisions in IS 4082:1996 (Reaffirmed 2018).
15) If e-mail facility is not available in POWERGRID approved Lab, report may be collected directly by POWERGRID/ Speed Post / Registered Post / UPC.
16) In case any Laboratory refuses to allow POWERGRID representative for witnessing the test, same shall be taken in writing and approval by Regional Head.
17) Standard marking of ISI mark along with license number (Seven digit no., represented as CM/L-----) should be verified for construction materials and test certificate submitted for review
18) The mix design shall be approved in line with standard format for mix design concrete and final approval of mix design shall be done in consultation with Regional engineering department. After approval, during first use, design mix shall be verified by testing cube samples for 7 days and 28 days.
19) Tolerance of cement weight shall be governed by IS 269: 2015 (Reaffirmed 2020) for OPC and by IS 1489 (Part 1) Reaffirmed 2020 for PPC.
20) Digital Photographs during concreting, erection and stringing for each location shall be taken and kept in record for future reference by high resolution GPS enabled camera.
21) All the charges in connection with NDT/ Core tests shall be borne by the contractor.
22) Bituminous paint should be applied wherever required check
23) The cube testing in in-house Cube testing machine shall be carried out by POWERGRID employee not directly associated with construction activities. The employees associated with O&M works should be preferred for carried out cube test.
24) Wherever reference to BIS Codes is made, it shall be the latest edition/revision of the same.



Annexure-6

ENGINEERING GUIDE LINE FOR CHECKING / ACCEPTING SOIL INVESTIGATION REPORT:

Following are the guide line for checking and accepting the soil investigation report:

The soil investigation shall be carried out in line with the Technical Specification. The detailed soil Investigation Report should be signed by the soil investigating agency, Line Contractor and POWERGRID's Site Engineer/RHQ Engineer and following points should be checked in the soil investigation report:

1) Normal Locations :

a) Soil investigation report should contain the bore Log sheet indicating the variation of different soil strata.
b) The Bearing capacity, Bulk density (γ) , Submerged Density(γ_{Sub}) , angle of repose (δ) in dry as well as wet condition and Angle of internal friction (ϕ) for different soil layers including at 3m depth shall be indicated in the Soil investigation report.
c) Present water table and history of variation of water table at the tower location shall be indicated in the soil investigation report.
d) Classification of foundation should be indicated based on the water table , Bearing capacity, Swelling Index, Soil type and the value of angle of repose (δ) in line with parameters indicated in the standard foundation drawings.

2) River Crossing /Special Locations:

a) A sketch indicating profile of river crossing locations with borehole positions shall be indicated in the soil investigation report.
b) Maximum discharge, Maximum velocity and Highest Flood Level (HFL) data (authenticated) of the river shall be enclosed in the Soil Investigation Report.
c) Comprehensive Bore log Sheet indicating the depth of different Strata, Soil type, SPT value & water table for each bore hole is to be indicated in the soil investigation report.
d) Natural Ground Level (GL) for all the locations are to be indicated. **Note that the GL & HFL should be with respect to same reference. For example if HFL is given in RL, the ground level should be in terms of RL only. Mixing of level with respect to MSL (Mean Sea level) & RL should be avoided.**
e) Whether the river is navigable or not is to be indicated in the soil investigation report.
f) Silt factor calculation based on the laboratory test results of weighted mean diameter (d_m) of soil for different layers of the soil shall be furnished in the soil investigation report.
g) Bulk density **(γ)**, Submerged Density **(γ_{Sub})**, Value of Cohesion (**C**) and Angle of internal friction (ϕ) for different soil layers based on laboratory test results shall be indicated in the soil investigation report.
h) If Rock is encountered prior to termination of bore hole (40m below existing Ground Level) , core drilling should be done. The details of core recovery (Run wise) and calculation of Rock Quality Designation (RQD) together with the photograph of core sample properly placed in a core Box are to be enclosed in the soil investigation report.
i) If the refusal is not obtained or the type of soil encountered at 40m depth below existing ground level is very poor (like loose clay, organic deposit etc.) further boring should be continued up to a depth of 50m below Ground Level or refusal whichever is earlier and all relevant data upto termination depth of bore holes shall be furnished in the Soil Investigation Report as detailed above.



Annexure-7

CONCRETE MIX PROPORTIONING-MIX DESIGN (to be furnished by site while sending samples for design mix)

S. No.	Design Stipulations	Specified Criteria for Mix Proportion
A 1.	CONCRETE DETAILS: Grade of Concrete (M 20 to M 60- 28 days compressive Strength of 150mm cubes)	M20 ☐ M25 ☐ M30 ☐ M35 ☐ M40 ☐
2.	Type of Concrete- Structural Classification	PCC ☐ RCC ☐ PSC ☐ Others ☐
3.	Placing Conditions of Concrete (Structural Elements)	Building ☐ TL Pile ☐ S/S Pile ☐ S/S Structure ☐ Road ☐
B 4.	MIX DESIGN LIMITS:* Max. Water-Cement Ratio (W/C)- Optional	0.30 ☐ 0.35 ☐ 0.40 ☐ 0.45 ☐ 0.50 ☐ Others ☐
5.	Min Cement Content- Optional- Kg/m3*	300 ☐ 320 ☐ 340 ☐ 360 ☐ 380 ☐ Others ☐
C 6.	EXPOSURE CONDITIONS:@ Type of Environmental Exposure	Mild ☐ Mod. ☐ Severe ☐ V. Severe ☐ Extreme ☐
7.	Whether Exposed to Sulphate attack from Soil, Water & Containment.	Yes ☐ No ☐ Not Known ☐
8.	Whether Exposed to Chloride attack from Soil, Water & Containment.	Yes ☐ No ☐ Not Known ☐
D 9.	CONCRETE INGREDIENTS: Source of Water for Construction	Ground ☐ River ☐ Pond ☐ Others ☐
10.	Type of Cement & Strength Grade.	OPC Gr.33 ☐ OPC Gr.43 ☐ OPC Gr.53 ☐ PPC BFS ☐ PPC FAB ☐ PSC ☐

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11.	Brand, Batch No./Week/Year of Cement(Test Certificate to be sent to Lab)	☐ ☐
12.	Cementitious Materials Proposed for Improvement of Density & Permeability.	Microsilica/ Silica Fume ☐ Slag ☐ Fly Ash ☐ Other Pozzolona ☐
13.	FRESH CONCRETE Properties: Desired Slump of Concrete (mm)#	25-55 ☐ 25-75 ☐ 100-150 ☐ Others ☐
14.	QUALITY CONTROL AT SITE: Degree of Quality Control at Project Site (For Standard Deviation)	V.Good ☐ Good ☐ Fair ☐ Std.Lab. ☐
15.	Max. Size of Coarse Aggregate (MSA)-mm	63 ☐ 40 ☐ 20 ☐ 12.5 ☐ 4.75 ☐ Other ☐
16.	Source of Coarse Aggregate	Name of Quarry Location
17.	Type of Fine Aggregate	River Sand ☐ Crushed Sand ☐ Others Specify ☐
18.	Source of Fine Aggregate (Sand)	Name of Quarry Location
19.	Admixture proposed to be Used (Batch MTC to be Submitted to Lab)	Brand Name: Batch No.:
20.	Type of Compaction Equipment	Plate Vibrator ☐ Needle Vibrator ☐ Vibro Hyd. Pressure ☐ Piling Concrete ☐
21.	Type of Concrete Placement Facility at Project	Manual Lift ☐ Hudraulic Bucket ☐ Concrete Pump ☐

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22	Maximum/Minimum temp. envisaged during placing of concrete	

* Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size- Reinforced Concrete

Minimum cement content (Kg/m3	Maximum free water cement ration	Minimum grade of concrete
300	0.55	M20
300	0.5	M25
320	0.45	M30
340	0.45	M35
360	0.4	M40

 # Slump Value as per SFQP;

i. For Switchyard civil works – 25 to 75mm
ii. For Switchyard pile foundations- 150-180mm
iii. For Transmission line open cast foundations- 25 to 75mm
iv. For Transmission line pile foundations- 150-180mm

ENVIRONMENT	EXPOSURE CONDITIONS
MILD	• Concrete surfaces protected against weather or aggressive
MODERATE	• Concrete exposed to condensation and rain • Concrete continuously under water • Concrete surfaces sheltered from rain or freezing whilst wet • Concrete in contact or buried under non-aggressive soil/ground water
SEVERE	• Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation • Concrete completely immersed in sea water • Concrete exposed to coastal environment
VERY SEVERE	• Concrete surfaces exposed to sea water spray, corrosive fumes, or severe freezing conditions whilst wet. • Concrete in contact with or buried under aggressive subsoil/ ground water
EXTREME	• Surface of members in tidal zone, Members in direct contact with liquid/solid aggressive chemicals

Note:- The design mix shall be tested for 7 and 28 days



Annexure-8

Standard procedure for Testing/Assessment of compressive strength of cast Concrete (Revision-I) issued vide IOM No: CC:FQA:SOP:2024 dated 05-07-2024



पावरग्रिड
POWERGRID

पावर ग्रिड कॉर्पोरेशन आफ इंडिया लिमिटेड
कारपोरेट एफ. क्यू .ए. विभाग
अतंर कार्यलाय ज्ञापन

प्रेषक: मुख्य महाप्रबंधक, एफ. क्यू .ए.
केंद्रीय कार्यालय

सेवा में : As per Distribution

संदर्भ संख्या: CC:FQA:SOP:2024

दिनांक: 05-07-2024

विषय: Revised (Revision 1) Standard procedure for Testing / Assessment of compressive strength of cast Concrete for nominal and design mix.

Please find enclosed herewith the Revised (Revision 1-SOP) Standard procedure for Testing / Assessment of compressive strength of cast Concrete, duly approved by competent authority. These guidelines are being issued both for nominal mix and design mix concrete. Henceforth, this standard operating procedure (Revision 1-SOP Annexure I) shall be applicable for all future projects of POWERGRID.

This issues with the approval of the Competent Authority.

Encl: Revision 1-SOP Annexure I (08 pages)

05/07/2024

(एम अशोक कुमार)

वितरण/Distribution:

1) **कार्यपालक निदेशक :** उत्तरी क्षेत्र-1/उत्तरी क्षेत्र-2/उत्तरी क्षेत्र-3 /पश्चिमी क्षेत्र-1/पश्चिमी क्षेत्र-2/ दक्षिण क्षेत्र-1/दक्षिण क्षेत्र-2/ पूर्वी क्षेत्र-1 /पूर्वी क्षेत्र-2/ उत्तर पूर्वी क्षेत्र/ Arunachal comprehensive T&D/एन. ई. आर .पी.एस. आई. पी./ ओड़िसा प्रोजेक्टस./टी.बी.सी.बी./ उप मुख्य सतर्कता अधिकारी/संविदा सेवाए/ अभियांत्रिकी /अभियांत्रिकी एच वी डी सी / एफ. क्यू .ए.
2) ES/PS of CMD/Director (Projects)/Director (Operation)/Director (Fin)/CVO
3) समस्त एफ. क्यू .ए. कार्यपालक

Standard procedure for Testing/Assessment of compressive strength of cast Concrete

Structural Elements

(A) Foundation shall be divided into two structural elements:

a) Foundation Pad(s)

b) Chimney/Column

(B) Pile foundation shall be divided into three structural elements:

a) Piles

b) Pile cap (s)

c) Pedestal

d) Tie Beam

(C) Building shall be divided into four structural elements:

a) Foundation pad(s)

b) Column

c) Beam

d) Slab

(D) Miscellaneous infrastructure works - cable trench, Fire wall, Boundary wall Panels, RCC roads , RCC drains

1.0 Acceptance Criteria:

For all RCC structures (such as Foundation Pad, Pile Cap & Pedestal, Roads/Drains/ Column / Chimney/ Cable Trenches/ Firewall/ Boundary wall panels, Beams, Columns & Slabs of Buildings.

1.1 Nominal Mix:

(i) **Acceptance of Concrete Cubes test results**

If test results of Concrete cubes & Cores are in between 70%-100% of specified grade of concrete, CPWD specifications Cl.no.5.4.10.4, Vol 1 shall be followed. Accordingly, the following may be adopted to consider the acceptance criteria of nominal mix concrete.

(a) The average of the strength of three (3) 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 strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength up to 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. No NDT such as UPV & RHT etc. shall be carried out.

(e) In case cube strength is less than 70% of specified strength, then structure shall be rejected (to be dismantled and recast) and thus no payment shall be made.

If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of cast concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance /non-acceptance of concrete based on test results. Regional head shall take further decision on non-accepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC -Engg. CC-Engg. will review the strengthening proposal and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

In case such structure is retained, part payment shall be paid as indicated in the payment procedure.

(ii) **Acceptance of Core test results:**

In case of nominal mix, Acceptance of Concrete Core test results (In case of doubt/strength

is less than 70% of specified strength/concrete cube test results not available).

Core test shall be carried out in case of doubt regarding desired compressive strength of concrete used either due to poor workmanship or based on results of cube strength tests/cube test results are not available.

The acceptability criteria adopted for concrete cube test results of Nominal Mix may also be applicable for Core test results.

1.2 Design mix: Concrete Cubes

Acceptable Compressive strength:- Acceptance of Concrete Cube test results considering average value of three specimens.

a) when mean of the group of four (4) non overlapping consecutive test results:
≥ fck + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm2)
or
fck + 3 N/mm2

whichever is greater for M 15 and above and Individual test results minimum ≥ fck-3 N/mm2

Notes:

i) In the absence of established value of standard deviation, the values given in Table -8 in IS 456-2000 may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

ii) For concrete quantity up to 30 m3 (where number of samples to be taken is less than four (4) as per the frequency of sampling given in 15.2.2 of IS 456:2000), the mean test results of all such samples shall be fck+4 N/mm^2, minimum and the requirement of minimum individuals test results shall be fck-2 N/mm^2, minimum. However, when number of sample is only one as per 15.2.2 IS 456:2000, the requirement shall be fck+4 N/mm^2, minimum.

In case cube strength is as per above, then full payment shall be released.

b) when compressive strength value is in between fck and fck+4/fck+3 as applicable, then the payment shall be made as indicated in the payment procedure. No NDT such as UPV & RHT etc. shall be carried out.

c) However, in invalid results cases, if there are no further samples available, the average of two (2) closest values may be considered for determination of compressive strength as per IS 516 (Part I/Sec I) 2021. The payment shall be made as indicated in the payment procedure.

d) In cases, compressive strength is less than fck and acceptance criteria brought out above, the structure shall be rejected.

If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of cast concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance/non-acceptance of concrete

based on test results. Regional head shall take further decision on non-accepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC -Engg. CC- Engg. will review the strengthening proposal and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

In case such structure is retained, part payment shall be paid as indicated in payment procedure.

1.3 Design Mix Concrete Core Test: - Acceptance of concrete core test results:(In case of doubt/If strength is less than Fck/ Concrete cube test results are not available)

Core test shall be carried out in case of doubt regarding strength of concrete used either due to poor workmanship or based on results of cube strength tests or less than fck (Characteristic cube compressive strength of concrete)/Concrete cube test results are not available.

If Average value of core specimens is 85% of the specified Grade of concrete and no individual value is less than 75% of the specified Grade of concrete and the same is considered acceptable as per *B-2.5.1 IS 516(Part4):2018.*

Any compressive strength deviation from the above, the acceptance/rejection procedure has been elaborated in Payment procedure.

1.4 No NDT (RH & UPV testing) test is required if concrete cube strength found in between 70% to 100 % for nominal mix and in between FCK and FCK+3/FCK+4 (as applicable) for design mix. However, If applicable, the NDT (UPV & RH testing) test is to be carried out and accepted as per latest IS 516 (Part-5, Sec-1)/516 (Part-5, Sec-4).

2.0 Payment Procedure:

For all RCC structures (such as Foundation Pad, Pile Cap & Pedestal, Roads/Drains/ Column / Chimney/ Cable Trenches/ Firewall/ Boundary wall panels, Beams, Columns & Slabs of Buildings)

2.1 Payment Procedure (Other than Pile): In case of Nominal Mix

For Concrete Cubes and Cores (Core shall be extracted in case of doubt/If specified strength is less than 70%, in average and individual/ Concrete cube test results are not available)

Acceptable Compressive strength- As per specified strength of concrete.

a) when Concrete cube or core strength equal or more than specified strength of Concrete, Full payment shall be applicable

b) when Concrete cube or core strength lies in between 70-100% of the specified strength of Concrete then payment shall be released on prorata basis for concrete portion and full payment shall be made on other components such as excavation, PCC, Reinforcement steel, Shuttering as applicable.

c) when Concrete cube or core strength is less than 70% of specified strength of Concrete, the Engineer-in-Charge shall reject the defective portion of work represented by sample and no payment shall be made for the rejected work inclusive of concrete, reinforcement steel, PCC, excavation etc.

d) If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of cast concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance /non-acceptance of concrete based on test results. Regional head shall take further decision on nonaccepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC-Engg. CC-Engg. will review the strengthening proposal. and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

In case such structure is retained, no payment shall be made for concreting & full payment of other components such as excavation, PCC, Reinforcement steel, shuttering if applicable as per original approved drawing/BOQ shall be made.

2.2 Payment procedure (Other than Pile) in case of Design Mix: Concrete Cubes

a) when mean of the group of four (4) non overlapping consecutive test results:
≥ fck + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm2)
or
fck + 3 N/mm2

whichever is greater for M 15 and above and Individual test results minimum ≥ fck-3 N/mm2

Notes:

i) In the absence of established value of standard deviation, the values given in Table -8 in IS 456-2000 may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

ii) For concrete quantity up to 30 m3 (where number of samples to be taken is less than four (4) as per the frequency of sampling given in 15.2.2 (Table 11) of IS 456:2000), the mean test results of all such samples shall be fck+4 N/mm^2, minimum and the requirement of minimum individuals test results shall be fck-2 N/mm^2, minimum. However, when number of sample is only one as per 15.2.2 IS 456:2000, the requirement shall be fck+4 N/mm^2, minimum.

In case cube strength is as per above, then full payment shall be released.

b) when compressive strength value is in between fck and fck+4/fck+3 as applicable, then the payment shall be released on prorata basis for concrete and full payment shall be made towards excavation, PCC, Reinforcement steel, Shuttering as applicable as per drawing/BOQ. No NDT such as UPV & RHT etc shall be carried out.

c) However, in invalid results cases, if there are no further samples available, the average of two (2) closest values may be considered for determination of compressive strength as per IS 516 (Part I/Sec I) 2021. In such cases when the compressive strength meets the specified strength of Concrete, payment for concrete portion shall be released on prorata basis and full payment on other components such as towards excavation, PCC, Reinforcement steel, Shuttering etc shall be made.

d) In cases, compressive strength is less than fck and acceptance criteria brought out above, the structure shall be rejected.

If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of cast concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance /non-acceptance of concrete based on test results. Regional head shall take further decision on non-accepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC -Engg. CC, Engg. will review the strengthening proposal and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

In case such structure is retained, no payment shall be made for concreting & full payment of other components such as excavation, PCC, Reinforcement steel, shuttering if applicable as per original approved drawing/BOQ shall be made.

2.3 Payment procedure (Other than Pile) in case of Design Mix: Concrete Cores

Concrete Cores (Core shall be extracted In case of doubt/If specified strength is less than fck, Concrete cube test results are not available)

The payment procedure for core test results is detailed below:

i) When equivalent cube strength is equal/more than fck+4/fck+3 as applicable, then full payment shall be made.

ii) When equivalent cube strength is in between fck and fck+4/fck+3 as applicable/When equivalent cube strength is in between 85% fck and no individual value is less than 75% of the specified Grade of concrete, the same is considered acceptable, prorata payment for concrete portion and full payment shall be made on other components such as excavation, PCC, Reinforcement steel, Shuttering as applicable.

iii) In case equivalent cube strength is less than 85%fck and/or an individual core has a strength less than 75%, then structure shall be rejected and thus no payment shall be made.

If, however the Engineer-in-Charge so desires, on critical/ urgent work, additional tests such as UPV, RHT, Core etc. shall be done at the cost of contractor in consultation with FQA to ascertain the quality of cast concrete. On the basis of proposal of site, FQA shall put up their recommendations to Regional-Head regarding acceptance /non-acceptance of concrete based on test results. Regional head shall take further decision on nonaccepted works whether the said concrete structure to be retained (with / without strengthening measures) or rejected (to be dismantled and recast).

If strengthening measures are chosen, a strengthening proposal with detailed reasons / justification for not rejecting the concrete shall be submitted to CC -Engg. CC, Engg. will review the strengthening proposal. and communicate their approval or revised drawing accordingly.

If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

In case such structure is retained, no payment shall be made for concreting & full payment of other components such as excavation, PCC, Reinforcement steel, shuttering if applicable as per original approved drawing/BOQ shall be made.

3.0 Acceptance Criteria & Payment procedure for Pile Foundations (Design Mix)

(i) In case of Pile foundation, when value of Average cube strength is fck+0.825xStandard Deviation or fck+4/fck+3 as applicable whichever higher, then Full payment shall be applicable.

(ii) when value of Average cube strength is equal to or more than fck but less than fck+0.825xStandard Deviation or fck+4/fck+3 as applicable which ever greater, then payment shall be released on prorate basis for concrete portion and full payment shall be made to all other components such as boring, SPT, Reinforcement steel, MS Liner, as applicable as per drawing/BOQ.

(iii) However, in invalid result cases, if there is no further samples available, the average of two (2) closest values may be considered for determination of compressive strength as per IS 516 (Part 1/Sec 1) 2021. In such cases when the compressive strength meets the specified strength of Concrete, payment for concrete portion shall be released on prorata basis and full payment on other components such as towards boring, Reinforcement steel, MS Liner, SPT etc as applicable shall be made.

(iv) In case compressive strength of cubes observed is less than fck, Vertical load test (routine test) shall be carried out in Pile foundations of Switchyard / Transmission lines wherever applicable in consultation with Engineering to ascertain the capacity of pile as per IS 2911(Part IV). If the test result is meeting the codal requirement, then 50 % payment shall be made for concrete & full payment shall be made towards Boring, Reinforcement steel, SPT, MS Liner as applicable in line with original approved drawings/BOQ.

Alternatively, for Transmission Line cases, if Head of the Region so desires, the proposal may be examined by Engineering for acceptance after carrying out suitable remedial measures including strengthening/ OR if structures are retained after due approval from

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Engineering without any rectification. In such cases, 50% payment shall be made for concrete & full payment shall be made towards Boring, Reinforcement steel, SPT, Liner as applicable in line with approved drawings/BOQ.

(v) If compressive strength of cube of piles observed is less than fck & not technically meeting /cleared by Engineering as brought out above, the structure shall be rejected and then no payment shall be paid for the rejected pile inclusive of concrete, boring, reinforcement steel, MS Liner etc.

4.0 General Notes: -

i) In case only one set of cube results are available for a location and results are found to be less than 70% of specified strength in case of Nominal Mix, all four legs of the location shall be analyzed as per the procedure as indicated in acceptance criteria.

ii) However, in case of locations where two or more set of cube results are available and results are found less than 70% of specified strength, in case of Nominal mix, then only one pit shall be excavated at a time (utmost care shall be taken to avoid any damage to concrete surface or disturb undercut zones of foundation) and analyzed those legs as per the procedure as indicated in acceptance criteria.

iii) The calibration certificate of the rebound hammer should be checked before commencement of a test.

iv) NDT (UPV & Rebound Hammer Test) or Core Test shall be conducted by POWERGRID approved laboratory. The lab shall be entrusted to carry out the testing which shall be witnessed by Site/FQA executive. The laboratory shall submit the report containing the UPV & Rebound Hammer Test or CoreTest results along with the field data.

v) Acceptance criteria of construction materials shall be as per SFQP/relevant IS codes.

vi) For core testing at least three specimens are required as per IS:516(Part-4). While extracting cores, four to five specimens may be taken from the foundation pads (uniformly distributed) such that three sound specimen may be used for testing. Otherwise repeat test shall be made. If cores of sufficient length cannot be extracted for testing due to poor quality of concreting/workmanship etc. as per IS: 516(Part-4), the foundation shall be treated as rejected.

vii) When core test is carried out, technical acceptance and commercial implications shall be governed solely on the basis of core test results. This shall be applicablefor both nominal and design mix concrete.

viii) For additional structures/piles if any installed in lieu of rejected structure/pile, no payment shall be made for the rejected pile and the additional pile shall be dealt as per the provisions of Contract.

ix) Generally, Core test should not be repeated after completion and availability of test reports for the same structure of the same batch of concrete.

x) No core extraction/test is permitted in case of pile foundations

xi) The provision of additional 5% Core testing as mentioned in SFQP's stands deleted.