

STANDARDISED FIELD QUALITY PLAN

Item	Transmission Line Pile Foundation
Applicability	POWERGRID Projects
Date of Issue	03.08.2020
Validity	Till next revision

SFQP No.	DOC No.C/FQA/SFQP/TL-PILE/031
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S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by POWERGRID	Accepting authority in POWERGRID
					Agency	Extent		
1.	Detailed Soil Investigation	a) Borelog	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 50 % at Field by Site Engineer 10% by Site in Charge	Site in charge
		b) Tests on samples	As per tech. Specs.	As per POWERGRID Specification	Contractor (Testing in POWERGRID approved soil testing agency)	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. POWERGRID and contractors jointly signed field data should be attached with the report.	Review of soil testing report by POWERGRID	Site in charge based on the guide line issued by CC Engg. attached as per Annexure-7
2.	Pile Foundation							
		A. Materials 1. Cement	1. Brand approval	Cement of approved brands according to the COV in POWERGRID web site may be procured and validity of BIS license to be ensured.	Contractor	100%	Any new brand cement proposed by Contractor shall be assessed by RHQ-FQA and approved by Regional Head. After approval, details shall be forwarded to CC-FQA/QA&I for uploading in COV.	FQA-RHQ



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			2. Physical tests	As per document at Annexure-I of this FQP	Samples to be taken jointly with POWERGRID and tested at POWERGRID approved lab	Review of 100% MTC's and one sample for every week No. of Manufacturer.	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	Review of all MTC's	100% review of MTC test results	Site In-charge
	2. a) Reinforcement Steel		1. Source approval	May be procured either from producers directly or 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. Validity of BIS license to be ensured.	Contractor	100%	Material shall be supplied from producers / authorized dealers.	Site Incharge.



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				2. Physical and Chemical analysis test	As per Annexure-2 of this FQP	Contractor to submit MTC	100% MTC One sample* / 300 MT / Manufacturer shall be jointly sealed by POWERGRID and tested at POWERGRID approved Lab. *Note: All sizes of 10mm and above shall be taken for testing in every 300 MT.	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
# # 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).									
	2.b) MS Liner (before Fabrication)		1. Source approval	From producers. (May be procured from any supplier which gives producer MTC.) Refer COV of plate supplier	Contractor		As proposed by Contractor	To review the proposal based on the documents.	Site In-charge.
			2. Physical and Chemical analysis test	As per Annexure-6 of this FQP	Contractor to submit MTC		All MTC's	100% review of MTC	Site In-charge
	2.c) M.S. Liner (after fabrication)		a) Diameter	As per construction drawings.	Contractor		100%	100%	Site In-charge



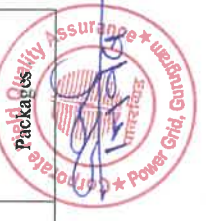
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			b) Painting	As per Specification	Contractor	100%	100%	Site In-charge
	3. Coarse Aggregates		1. Source approval	Source with materials meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of Joint samples tested 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 tests	As per document at Annexure-3 of this FQP	Contractor	One sample per 200 cum or part thereof, Samples to be tested by Contractor in POWERGRID accepted lab.	100% review of lab test results	Site In-charge
	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 source shall be used for all the running contracts under various Packages



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			2. Physical test	As per Annexure-4 of this FQP	Contractor	One sample per 200 cum or part thereof, Samples to be tested by Contractor in POWERGRID accepted lab.	100% review of lab test results	Site In-charge
		5. Water	1. Cleanliness	POWERGRID Specification (Water shall be fresh and clean)	Contractor	100% visual check at Field	Verification at random	Site Engineer
			2. PH Value	- do -	Contractor	One sample per source	100% review of the test results Ph not less than 6	Site Engineer
	B) Before concreting of piles		1. Check for center line of each pile	Construction Drawings	Contractor	100%	100%	Site Engr.
			2. Check for diameter /verticality of each pile Check	-do-	-do-	-do-	-do-	-do-
			3. Check for depth of each pile	-do-	-do-	-do-	-do-	-do-



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			4 Diameter of borehole	Construction Drawings	Contractor	100%	100%	Site Engr.
			5. Cut off & Founding level of each pile	-do-	-do-	-do-	-do-	-do-
			6 Sp. Gravity of bentonite slurry	As per Specification	-do-	-do-	-do-	-do-
			7. SPT	As per Specification	-do-	-do-	-do-	-do-
			8.Sp. Gravity of bentonite at founding level	As per Specification	-do-	-do-	-do-	-do-
			9. Placement of reinforcement steel and its cover.	Bar bending schedule of construction drawing	-do-	-do-	-do-	-do-
		C) Before concreting of pile caps & chimney						



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		a) Bottom of excavated earth	Depth of foundation	Construction. Drgs.	Pile Contractor/ TL tower contractor	100% at Field	100% check by POWERGRID	Site Engineer
		b) Stub/Anchor bolt setting	1) Centre Line	-do-	-do-	-do-	-do-	*-*do-
			2) Diagonals & Back-to-Back	-do-	-do-	-do-	-do-	*-*do-
			3) Level of stubs/Anchor plates	-do-	-do-	-do-	-do-	*-*do-
		c) Reinforcement	Placement of reinforcement steel & its cover	Bar bending schedule of construction drawing	Contractor	-do-	-do-	Site Engineer *-* At least 5% locations shall be cross verified by immediate Reporting officer/ Site In charge, at Random with respect to stub setting and reinforcement steel placement.
		d) Concrete mix proportion (Applicable for Design Mix)	Ratio of mix proportion	Approval of Design Mix submitted by contractor based on inputs furnished by	-do-	-do-	-do-	Site In charge in consultation with Regional Corporate Power Grid, Gurgaon



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				POWERGRID as per Annexure- 8 of this FQP.				engineering department.
	D)During concreting a) Pile- Workability		Slump test	150- 180 mm as per POWERGRID Specn.	Contractor	Every one hour for each pile	100% at field	Site Engr.



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		b) Concrete strength	Cubes compressive strength	As per POWERGRID Specn. & Annexure-5	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	Two set of cubes (3 nos. cubes for each set) for each pile and tested one set for 7 days strength and one set for 28 days strength. For the Pile caps, beams, Chimney, one set of 3 nos. of cubes for every 20 cum or part thereof for each day of concreting and tested for 28 days strength. NOTE: Apart from cube testing, the CORE testing on pile foundations shall be carried out on 5% of total locations on sampling basis. For one location, any one pile cap shall be tested on sample basis. The sampling should be planned in such a way that the locations are tested within 45 days	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. 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.	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 witness at TPL by POWERGRID Site Engineer and at least 5% samples at random, shall be witnessed by Site In-charge



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		c) Consumption of Concrete Volume	Rate of concreting w.r.to length of built up pile	Theoretical Volume (Actual volume should be greater than theoretical volume)	Contractor.	Every Pile	100%	Site Engineer
		E) P.C.C (Grade, Thickness & Size)	completeness	IS:456 and POWERGRID approved foundation drawings & specification	CONTRACTOR	For all locations	Joint Inspection by POWERGRID and CONTRACTOR	Site Engineer
		Pile Cap and Chimney-Workability	Slump test	25- 75 mm as per POWERGRID Specn.	Contractor	Minimum Two per day per location, preferably one at the start of concreting	check at random	Site Engineer
3.	Pile Integrity Test	Pile	1) Integrity of Pile	As per Specification	Contractor (By POWERGRID approved Testing agency)	100%	(POWERGRID to witness tests)	Site Engineer
			2) Pile Profile analysis 3) Impedance profile	As per Specification	Contractor (By POWERGRID approved Testing agency)	100%	(POWERGRID to witness tests)	Site in charge to submit report to Regional Engg. for approval



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4	Chipping of Pile head	Pile head	a) Removal of loose Material	As per Specification & IS:2911	Contractor	100%	100%	Site Incharge.
			b) Exposure of reinforcement steel	As per Specification & IS:2911/Construction drawing	Contractor	100%	100%	Site Engr.
			c) Cut off Level of Pile	As per construction drawings	Contractor	100%	100%	Site Engr.
		NDT/Core test	UPV and Rebound Hammer /Core test	Refer POWERGRID's Standard procedure for Testing/Assessment of compressive strength of casted Concrete				
								Regional Head



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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT

ORDINARY PORTLAND CEMENT

S. No.	Name of the test	Ordinary Portland Cement grade as per IS 269: 2015	Ordinary Portland Cement 43 grade as per IS 269: 2015	Ordinary Portland Cement 53 grade as per IS 269: 2015	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 cm ² per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm ² per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm ² per gm.	Blaine's air permeability method as per IS 4031 (Part-2):1999, Reaffirmed 2013
(ii)	Compressive strength	72 ± 1 hour : Not less than 16 Mpa (16 N/mm ²) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm ²) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm ²), Not more than 48Mpa (48N/mm ²)	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/mm ²)	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 2014
(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 2014. -do-
(iv)	Soundness	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatelier and 0.8% by Autoclave test.	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatelier and 0.8% by Autoclave test	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatelier and 0.8% by Autoclave test.	Le Chatelier and Autoclave test as per IS 4031 (Part-3): 1988, Reaffirmed 2014



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S. No.	Name of the test	Ordinary Portland Cement 33 grade as per IS 269: 2015	Ordinary Portland Cement 43 grade as per IS 269: 2015	Ordinary Portland Cement 53 grade as per IS 269: 2015	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 sulphuric anhydride (SO ₃), percentage by mass not more than 3.5%.	e) Total sulphur content calculated as sulphuric 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 4.5 percent	
		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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S. No.	Name of the test		Remarks
2.	PORTLAND POZZOLANA CEMENT AS PER IS 1489 (Part 1):2015		
a)	Physical tests	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
	i) Fineness		
	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 chatelier test and 0.8% by Autoclave test as per IS 4031 (Part-3)	
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 sulphuric anhydride (SO ₃), percentage by mass not more than 3.5		-do-
	d) Total loss on ignition shall not be more than 5 percent		
	e) Chloride content, percent by mass, max 0.1%		



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Annexure-2

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL AS PER IS 1786-2008 (Reaffirmed 2013), Amendment No- 1

S. No.	Name of the test	Fe 415	Fe 500	Fe 500D
i)	Chemical analysis test			
	Carbon	0.30 Percent Maximum	0.30 Percent Maximum	0.25 Percent Maximum
	Sulphur	0.060 Percent Maximum	0.055 Percent Maximum	0.040 Percent Maximum
	Phosphorus	0.060 Percent Maximum	0.055 Percent Maximum	0.040 Percent Maximum
	Sulphur & Phosphorus	0.11 Percent Maximum	0.105 Percent Maximum	0.075 Percent Maximum
	Carbon Equivalent	0.42 percent Maximum	0.42 percent Maximum	0.42 percent Maximum
ii)	Physical tests			
	a) Tensile Strength/Yield stress ratio,	≥ 1.10 , but tensile strength not less than 485.0 N/mm ²	≥ 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
	b) 0.2% of proof stress/Yield stress Minimum, N/mm ²	415	500	500
	c) Elongation percent , Minimum	14.5	12	16
	d) Total elongation at maximum force, percent, Minimum	--	--	5
	e) Unit weight, Kg/m on sample sent for third party lab	As per IS 1786	As per IS 1786	As per IS 1786
iii)	Bend & Rebend tests	Pass	Pass	Pass



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Annexure-3

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383:2016

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								



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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



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Annexure-4

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383

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



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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 be between 150 to 180 mm for pile and 25 to 75 mm for pile cap and chimney depending upon workability requirement as per IS 456: 2000.
		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 (26N/mm ²) and for 1:2:4 (Cement: Fine Aggregate: Coarse Aggregate) nominal mix concrete 28 days strength shall be min 210Kg/cm ² (20.6N/mm ²).

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

- 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.
- 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.
- 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.
- 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 after reconfirmation by NDT/Core test on the location portion represented by the cube samples in line with approved Standard testing procedure of POWERGRID.
- 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



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taken at the risk and cost of contractor. 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.

- 2) 53 Grade cement conforming to IS 455: 2015 may be used as per Technical Specification.
- 3) Portland slag cement conforming to IS 455: 2015 may be used as per Technical Specification.
- 4) All Design Mix concrete shall be as per IS 456: 2000, reaffirmed 2016
- 5) **ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR DESIGN MIX CONCRETE: As per Table-11, Amendment No. 4 of IS 456: 2000 as given below: Note sheet reference no. CC/FQA/CLA/MIX dated 08/12/16 approved by Competent Authority.**

Specified Grade	Case No.	Sampling	Acceptance Criteria for Mix Design as per IS 456:2000	Remarks
M15 and above	A 1.	Mean of Group of 4 non-overlapping consecutive test results.	Shall greater than or equal to $f_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5 N/sq. mm)* Or $f_{ck} + 3$ N/sq. mm, whichever is greater	
	A 2.	Individual test result out of A 1.	Greater than or equal ($f_{ck}-3$) N/ sq.mm	Out of four non- overlapping consecutive test results, one individual test result only.
	B 1.	Group of non-overlapping consecutive if test results are less than 4	$f_{ck} + 4$, N/sq.mm, minimum	
	B 2.	Individual test result out of B 1.	$f_{ck} - 2$, N/sq.mm, minimum	Out of less than four non- overlapping consecutive test results, one individual test result only.
	C 1	When number of sample is only one.	$f_{ck} + 4$, N/sq.mm, minimum	

* Established value of standard deviation shall be determined based on Note of Table-11 of IS 456

- 6) The test results of the sample shall be the average of the strength of the three specimens. The individual variation shall not be more than $\pm 15\%$ of the average.



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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.
- 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 2012 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 2016.



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- 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 2015.
- 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 2003.
- 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.*
- 19) *Tolerance of cement weight shall be governed by clause no. 10.1.1 of IS 269:2015 for OPC and by clause no. 10.1.1 of IS 1489 (Part 1):2015 for PPC.*
- 20) *Digital Photographs during soil investigation (Sampling) 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) *Design mix for pile and pile cap shall be done separately considering slump value.*
- 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.*



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Annexure-6

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR MILD STEEL LINER

S. No.	Name of the test	Mild steel as per IS 2062 (Fe410WA grade)
i)	Chemical analysis test	Carbon (For 6mm thick) 0.23% Max. Manganese 1.50% Sulphur 0.05% Phosphorus 0.05% Silicon 0.4%
		Carbon Equivalent = 0.42% for semi killed or killed
ii)	Physical tests	a) Ultimate Tensile stress = 410 N/Sq.mm. (min.) b) Yield stress 250 N/Sq.mm. (min.) c) Percentage of elongation 23%
iii)	Bend & Rebend tests	Pass



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Annexure-7

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 :

- Soil investigation report should contain the bore Log sheet indicating the variation of different soil strata.
- 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.
- Present water table and history of variation of water table at the tower location shall be indicated in the soil investigation report.
- 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 sketch indicating profile of river crossing locations with borehole positions shall be indicated in the soil investigation report.
- Maximum discharge, Maximum velocity and Highest Flood Level (HFL) data (authenticated) of the river shall be enclosed in the Soil Investigation Report.



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- 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.



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Annexure-8

CONCRETE MIX PROPORTIONING-MIX DESIGN

S. No.	Design Stipulations	Specified Criteria for Mix Proportion									
A	CONCRETE DETAILS:	M20	M25	M30	M35	M40					
1.	Grade of Concrete (M 20 to M 60- 28 days compressive Strength of 150mm cubes)										
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	MIX DESIGN LIMITS:*	0.30	0.35	0.40	0.45	0.50	Others				
4.	Max. Water-Cement Ratio (W/C)- Optional										
5.	Min Cement Content- Optional- Kg/m3*	300	320	340	360	380	Others				
C	EXPOSURE CONDITIONS:@	Mild	Mod.	Severe	V. Severe	Extreme					
6.	Type of Environmental Exposure										
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							



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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 FAB PSC
		☐	☐	☐	☐
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	
		☐	☐	☐	☐



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		Name of Quarry	Location
18.	Source of Fine Aggregate (Sand)		
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	
22	Maximum/Minimum temp. envisaged during placing of concrete		

- For Switchyard civil works – 25 to 75mm
- For Switchyard pile foundations- 150-180mm
- For Transmission line open cast foundations- 25 to 75mm
- For Transmission line pile foundations- 150-180mm

@EXPOSURE CONDITIONS



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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



