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Item	Switchyard Civil works
Applicability	POWERGRID Projects
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Validity	Till next revision

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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) Bore log**	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per POWERGRID Specification	**Contractor**	100% at Field	To witness 20% at Field	Site Engineer
		b) Tests on samples	As per tech. Specs.	As per POWERGRID Specification	**Contractor (Testing in POWERGRID *approved Lab)***	100% by testing lab (Reports to be signed by Testing person & Checking person)	Review of lab test results (All soil reports to have signature of POWERGRID executive reviewing the report)	Site In-charge based on the guide line issued by CC Engg. as Annexure-6
2.	**Earth Work (site leveling)**							
		1. Mandatory testing for filling						
			1. Proctor compaction test for maximum dry density	IS:2720 (Part-7) & POWERGRID Specification	Contractor from *POWERGRID* approved Lab.	One sample per 25000 Cum. for each type & source of filling material.	100% review of lab test results	Site In charge
			2. Optimum Moisture Content	do	Contractor from *POWERGRID* approved Lab.	do	do	do
		2. Field Compaction Test	1. Field dry density & Moisture content test for each layer of compaction.	IS:2720 (Part-29), & POWERGRID Specification	Contractor Field lab./ *POWERGRID* approved Lab.	One sample for every 2500 Sqm. or part there of for compacted soil for each compacted layer.	do	do

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					Agency	Agency		
3.	**Checking of foundation Material**							
	A. Materials	1. Cement	1. Brand approval	Cement of approved brands according to the COV in POWERGRID web Site may be procured.	Contractor	As proposed by Contractor	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-QA&I/*FQA for* uploading in COV.	FQA-RHQ
			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.*	**Review of 100% MTC's and one sample for every Batch 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 to submit MTC	**Review of all MTC's**	**100% review of MTC 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	Contractor	**As proposed by contractor.**	Material shall be supplied from producers / authorized dealers.	Site in charge.

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			2. Physical and Chemical analysis test	As per Annexure-2 of this FQP	Contractor to submit MTC	100% MTC's 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 300MT.	100% review of MTC and embossing. 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
	# # 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) Miscellaneous structural steel excluding cable trench, transformer & reactor foundation.	**Source to be proposed by contractor.**	**Source with material meeting POWERGRID Specification**	**contractor**	**As proposed by contractor**	**To verify documents.**	Site In charge
			1. Dimensional check **2. Visual check for damages rusting pitting etc.**	POWERGRID specification and approved drawing.	Contractor	100%	random	Site Engineer
		2. c) Structural steel used in cable trench, transformer & reactor foundation.	**Source to be proposed by contractor.**	**POWERGRID Specification**	**Contractor**	**As proposed by contractor**	**To verify documents.**	

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			1. Dimensional check	POWERGRID specification and approved drawing	Contractor	100%	random	Site Engineer
			2. Visual check for damages rusting pitting etc.	POWERGRID specification and approved drawing	Contractor	100%	random	Site Engineer
			3.Visual check for welding defects primer coating and painting/ galvanizing as applicable	POWERGRID specification and approved drawing	Contractor	100%	Random	Site Engineer
			4. Physical properties of Structural steel	IS 2062: 2011, reaffirmed 2016 POWERGRID specification and approved drawing	Contractor	1 sample per lot of 40MT or part thereof for tensile tests and 1 sample per lot of 20MT or part thereof for bend test of each size.	Review of lab test results by POWERGRID.	Site Engineer
		3. Coarse Aggregates	1. Source approval	Source meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry & 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 source shall be used for all the running contracts under various Packages.

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					Agency	Extent		
			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 500 cum or part thereof per source, Samples to be tested by Contractor in POWERGRID *approved lab.***	100% review of lab test results. **Out of these 100% samples, POWERGRID shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.**	Site In charge
		4. Fine aggregate	1. Source approval	**Source 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.
			2. Physical test	**As per Annexure-4 of this FQP**	Samples to be taken jointly and tested in POWERGRID *approved lab*	**One sample per 500cum or part thereof per source, Samples to be tested by Contractor in POWERGRID *approved lab.***	100% review of lab test results. **Out of these 100% samples, POWERGRID shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.**	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

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			2. PH Value	- do -	Contractor	One sample per source	100% review of the test results Ph value not less than 6	Site Engineer
		6.Finishing materials of building	Physical verification of Different items as per specification	As per Specification.	Contractor	100%	MTC/Manufacturer catalogue To be reviewed by POWERGRID.	Site In charge.
	B. Concrete Works a)Before concreting							
		1. Dimensions of excavation	**Dimension & Depth of foundation**	Approved Drawing.	Contractor	100% at Field	100% check by POWERGRID	Site Engineer
		2. Stub Setting/Setting of Foundation Bolts, Embedments etc.	1) Centre Line	-do-	-do-	-do-	-do-	*-*-do-
			2) Diagonals	-do-	-do-	-do-	-do-	*-*-do-
			3) Level of stubs./ Foundation bolts	-do-	-do-	-do-	-do-	*-*-do-

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					Agency	Extent		
		3. Reinforcement steel	Placement	Bar bending schedule	-do-	-do-	-do-	-do *-*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
		4. Concrete mix proportion (Applicable for Design Mix)	Ration of mix proportion	Approval of Design Mix submitted by contractor based on inputs furnished by POWERGRID as per Annexure- 9 of this FQP.	-do-	-do-	-do-	Site In charge.
	b) During concreting	1. Workability	Slump test	Range 25 mm to 75 mm refer document at Annexure-5 of this FQP	Contractor	Minimum 01 sample per day	20% check at random	Site Engineer

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					Agency	Agency		
		2. Concrete Strength	Cubes Compressive Strength	As per POWERGRID Specifications & Annexure-5 of this FQP	Contractor Casting of cubes at site. Cubes to be tested for 28 days strength at POWERGRID approved Lab /POWERGRID Lab/At site (if testing machine installed by contractor is duly calibrated by NABL Lab.) Cubes at 100% location are to be taken in presence of POWERGRID officials.	One sample of 3 cubes for every 20 Cum or part thereof. (Mini. Qty. required for testing is 5 cum. for each day of concrete).	100% review of Lab test results. Cubes at 100% location are to be taken in presence of POWERGRID officials. Normally testing shall be carried out at the Cube Testing Facility installed at POWERGRID premises, in the witness of POWERGRID. Alternatively, samples shall be tested at 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.** **Further, POWERGRID to witness testing on 20% samples and also to review 100% test results.**	Site Engineer. 10% samples to be witnessed at TPL by POWERGRID Site Engineer and at least 5% samples at random, shall be witnessed by Site In-charge. In-case of Site / POWERGRID Lab, 100% witnessed by POWERGRID representative.

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	c)After Concreting	Back filling	a) Watering & Ramming for compaction	POWERGRID Specification	Contractor	100%	Random	Site Engr.
			b) Compaction Test	POWERGRID Specification	Contractor At Site/ Power grid Accepted Lab	a) One Sample of three specimen for 50% of tower location b) One Sample of three specimen for 20% of Equipment Foundation location c) 3 Samples (three specimen for one sample) for every Building (The depth of sampling and the locations shall be decided by Site Engineer)	Physically at Random & 100% review of Test results	Site In charge
		NDT/Core Tests	**UPV and Rebound Hammer /Core test**	**Refer POWERGRID's Standard procedure for Testing/Assessment of compressive strength of casted Concrete**				Regional Head
4.	**Pile foundations**	**REFER SFQP OF SWITCHYARD PILE WORK**						

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5.	**Brick Masonry**							
		a) BRICKS	1.Dimensional tolerance	POWERGRID Specification/enclosed Annexure 6	Contractor (samples to be taken jointly and tested in POWERGRID accepted lab)	Enclosed Annexure 6	Review 100% of test results	Site Engineer
			2.Compressive strength	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
			3.Water Absorption	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
			4.Efflorescence	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
		b) Mortar Mix	Cement sand Proportion	As per POWERGRID Specification	Contractor	100%	random	Site Engineer
6.	**P.C.C**	Grade , thickness, plan dimension	completeness	IS 456: 2000, reaffirmed 2016 and POWERGRID approved foundation drawings & specification	Joint Inspection by POWERGRID and CONTRACTOR	For all locations	Joint Inspection by POWERGRID and CONTRACTOR	Site Engineer
7.	**PLASTERING**							
		1.Plastering	thickness and evenness	As per POWERGRID Spec.	Contractor	100%	Random	Site Engineer

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		2. ingredients	Mortar Mix/Proportion	As per POWERGRID Spec.	Contractor	100%	Random	Site Engineer
8.	**Switchyard earthing**							
		1. Check for dimension of earth mat	Physical check	POWERGRID spec & approved drawings	contractor	100%	Random	Site Engineer
		2. Depth of excavation	Physical check	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engineer
		3. Check for weld joints and anti corrosion treatment	Physical check	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engineer
9.	**Site surfacing**							
		1.Leveling,Level & Height & evenness	Physical Check	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engineer
		2. Soil sterilization : spraying of chemicals	Physical Check	POWERGRID spec & manufacturers recommendations	Contractor	100%	random	Site Engineer
		3. P.C.C (Grade, thickness & Size) a) PCC 1:5:10 (1 cement:5	Completeness	POWERGRID specifications	Joint Inspection by POWERGRID and Contractor	100%	Random	Site Engineer

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		coarse/fine sand:10 burnt brick aggregates) b)Burnt brick aggregate of nominal size 40 mm	Grading	As per Annexure-8	Samples to be taken jointly & tested in POWERGRID accepted lab.	1 sample per 500 cu.mtr	100% review of lab test results	Site In-charge
		4. 20/40mm stone aggregate	Grading	IS 383: 2016, *IS: 2386: Part 1, reaff. 2016* and POWERGRID Specification. The grading shall be as per single sized nominal size.	Contractor (POWERGRID accepted lab)	1 sample per lot of 500 Cubic Meter or part thereof from each source for each size.	100% review of test report	Site Engineer
		5. Resistivity of 20/40mm stone aggregate.	Electrical Check	POWERGRID Technical Specification. (resistivity of the stone for spreading over the ground shall be minimum 3000 ohm-m under wet condition)	Contractor	1 sample of stone from each source (in case stones are supplied from more than one source)	100% review of test report.	Site Engineer
		6. Compacted thickness of 20/40mm stone layers as applicable	Physical	POWERGRID specification & approved drawings	Contractor	100%	Random	Site Engineer
10	**Road (WBM layers)**							
		1. Alignment & Level	Physical check	POWERGRID specification & approved drawings	Contractor	100%	100%	Site In charge

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					Agency	Extent		
	Material	A. 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
			2. Physical tests	As per document at Annexure-7 of this FQP	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per lot of **200** cum or part thereof per source	100% review of lab test results	Site In charge
		B)Stone Screening						
			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 accepted lab	To review the proposal based on the documents	Site In charge
			2. Grading	As per document at Annexure-7 of this FQP	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per lot of **200** cum or part thereof	100% review of lab test results	Site In charge
		C)Binding Material	Plasticity index	As per document at Annexure-7 of this FQP	Contractor	One sample per lot of **25** cum or part thereof	100% review of lab test results	Site In charge
		D) Laying of sub base Course	Physical check	As per CPWD spec clause 17.7.2	Contractor	100%	Random	Site Engineer

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		E) Laying of base Course	Physical check	As per CPWD spec clause 17.8.1	Contractor	100%	Random	Site Engineer
11	**Drain**	Alignment and invert level	Physical	POWERGRID spec and approved drawing	Contractor	100%	Random	Site Engineer

Annexure-1
(Sheet 01 of 03)

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***	**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 Appd. 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 2013
(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 (48 N/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 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	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 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 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.	**POZZOLANA PORTLAND CEMENT AS PER IS 1489 (Part 1): 2015**			
a)	**Physical tests**			To be conducted in POWERGRID approved Lab
		i) Fineness	Specific surface area shall not be less than 300m^2/Kg. or 3000 cm^2/gm.	IS 4031 (Part-II)
		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)	IS 4031 (Part-VI)
		iii) Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	IS 4031 (part-V)
		iv) Soundness	Unaerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier 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 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		
		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	**0.110 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*
iii)	**Bend & Rebend tests**	Pass	Pass	*Pass*

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 grades 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 deletrious 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)		12% when tested with sodium sulphate and 18% when tested with magnesium sulphate								

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*

Annexure-4

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

4.	**Fine aggregates**				
i)	Physical Tests	**IS Sieve Designation**	**Percentage passing for graded aggregate of nominal size**		
	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*			

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 2016.
		b) Compressive strength	**For Design mix as per IS:456 for Grade M15 or above** **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 and for 1:2:4(Cement: Fine Aggregate: Coarse aggregate) nominal mix concrete 28 days strength shall be min 210Kg/cm^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***

(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 upto 30% then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate after reconfirmation by NDT/Core test on the location portion represented by the cube samples.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of 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 shall be used after obtaining specific approval of the Engineer in charge.
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 fck+0.825 x established standard deviation (rounded off to nearest 0.5 N/sq. mm)** *Or* *fck + 3 N/sq. mm, whichever is greater*	
	A 2.	*Individual test result out of A 1.*	*Greater than or equal (fck+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*	*fck + 4, N/sq.mm, minimum*	
	B 2.	*Individual test result out of B 1.*	*fck - 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.*	*fck + 4, N/sq.mm, minimum*	

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

Annexure- 6

(Sheet 01 0f 02)

SAMPLING PLAN FOR BRICK-WORK

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

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

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

Scale of sampling for physical characteristics

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

STANDARD FIELD QUALITY PLAN

Item	Switchyard Civil works
Applicability	POWERGRID Projects
Date of Issue	29.05.2018
Validity	Till next revision

SFQP No.	DOC No.C/FQA/SFQP/SCW
REV.	05

Annexure- 6

(Sheet 02 0f 02)

ACCEPTABLE CRITERIA FOR BRICK WORK

1) Dimensional Tolerances: The dimensions of modular/ Non modular bricks when tested shall be within the following limits per 20 bricks.

S. No	DESCRIPTION	MODULAR BRICKS	NON-MODULAR BRICKS
1	LENGTH	372 to 388 cm (380± 8 cm)	*452 to 468 cm (460 ± 8 cm)*
2	WIDTH	*176 to 184 cm (180± 4 cm)*	*216 to 224 cm (220 ± 4 cm)*
3	HEIGHT	176 to 184 cm (180± 4 cm)	*136 to 144 cm (140 ± 4 cm)*

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

3) Water Absorption: The average water absorption of bricks shall not be more than 20% by weight.

4) Efflorescence: The rating of efflorescence of bricks shall not be more than moderate.

PHYSICAL, REQUIREMENT OF COARSE AGGREGATE

S.No.	Type of Constn.	Type of W.B.M	Test Method	Requirements
1.	Sub-base	Los Angeles Abrasion Value or Aggregate Impact value	IS 2386 (Part-IV) IS 2386 (Part-IV) IS 5640***	60% max. * 50% max
2.	Base	a) Los Angeles Abrasion Value or Aggregate Impact value b) Flakiness Index	IS 2386 (Part-IV) IS 2386 (Part-IV) IS 5640*** IS 2386 (Part-I)	50% max. * 40% max ** 15% max
3.	Surface Course	a) Los Angeles Abrasion Value or Aggregate Impact value b) Flakiness Index	IS 2386(Part-IV) IS 2386 (Part-IV) IS 2386 (Part-I)	40% max. 30% max **15% max
4	Binding Material	Plasticity index	IS 2720 (Part-V)	Less than 6

* Aggregates may satisfy requirements of either of the two tests

** The requirements of flakiness index shall be enforced only in case of crushed/broken stone and crushed slag.

*** Aggregates like brick metal, kankar and laterite which get softened in presence of water, shall be tested for impact value under wet conditions in accordance with IS 5640.

GRADING REQUIREMENTS OF COARSE AGGREGATE FOR W.B.M

Grading No.	Size Range	Sieve designation	% by weight passing the sieve
1	90mm to 45mm (Suitable for sub base courses of compacted layer of not less than 90mm thickness).	125mm 90mm 63mm 45mm 22.4mm	100 90-100 25-60 0-15 0-5
2.	63mm to 45mm	90mm 63mm 53mm 45mm 22.4mm	100 90-100 25-75 0-15 0-5
3.	53mm to 22.4mm	63mm 53mm 45mm 22.4mm 11.2mm	100 95-100 65-90 0-10 0-5
4	Screening		
	A) 13.2 mm	13.2 mm 11.2 mm 5.6 mm 180 micron	100 95-100 15-35 0-10
	B) 11.2 mm	11.2 mm 5.6 mm 180 micron	100 90-100 15-35

Annexure-8

Requirement of grading of broken Burnt Brick Coarse aggregate

IS Sieve Designation	Percent Passing
75 mm	100
37.5 mm	95-100
19.0 mm	45-75
4.75 mm	0-5

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 Incharge means incharge of the Site. 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 Site 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.

12) **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.

.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) Three samples of each size of steel (all sizes of 10mm & above) out of 100MT steel Lot need to be physically weighted to ascertain their acceptance as per technical specification. The weighted samples at site may be kept under custody for three months.

16) If e-mail facility is not available in POWERGRID approved Lab, report may be collected directly by POWERGRID /Speed Post / Register Post / UPC.

17) In case any Laboratory refuses to allow POWERGRID representative for witnessing the test, same shall be taken in writing and approved by Regional Head.

18) Latest IS codes shall be followed.

19) Standard marking of ISI mark along with license number (Seven digit no., represented as CM/L-----) should be verified for construction materials.

20) 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.

21) 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.

22) Digital Photographs during major construction activities shall be taken and kept in record.

23) All the charges in connection with NDT/ Core tests shall be borne by the contractor.

Annexure-9

CONCRETE MIX PROPORTIONING-MIX DESIGN

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 ☐

STANDARD FIELD QUALITY PLAN

Item	Switchyard Civil works
Applicability	POWERGRID Projects
Date of Issue	29.05.2018
Validity	Till next revision

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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 ☐
11.	Brand, Batch No./Week/Year of Cement(Test Certificate to be sent to Lab)	☐ ☐
12.	Cementitous 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 ☐
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

@EXPOSURE CONDITIONS

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