

**STANDARD FIELD QUALITY PLAN**

Item	Switchyard Pile Foundation
Applicability	POWERGRID Projects
Date of Issue	10-07-2024
Validity	Till next revision

SFQP No.	DOC No.C/FQA/SFQP/SCW-PILE
REV.	08

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		
1.	Detailed Soil Investigation a) Bore log	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per POWERGRID Specification	<b>Contractor (Soil testing agency approved by POWERGRID)</b>	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	<b>Contractor (Testing in POWERGRID approved soil testing agency)</b>	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. as per Annexure-6
2	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	As proposed by Contractor	Any new brand cement proposed by Contractor shall be assessed by RHQ-FQA and approved by Regional Head with BIS License, validity. After approval, details shall be forwarded to CC-FQA for uploading in COV	FQA-RHQ
		2. Physical tests	As per document at Annexure-I of this FQP	<b>Contractor</b> Samples to be taken jointly with POWERGRID and tested at POWERGRID approved lab	<b>(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*</b>	<b>100% review of lab test results. Test results shall be sent by the Lab. by E-mail directly to POWERGRID. Further, a hard copy of test certificate shall also be sent by the Lab directly to POWERGRID by postal Address.*</b>	Site In-charge

\* Corrected content



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					(ii) Testing (Physical & Chemical) shall be done in case storage of cement is more than three (3) months from the manufacturing date*		
		3. Chemical Tests Chemical composition of Cement	-do-	Contractor to submit MTC	Review of all MTC's	100% review of MTC results	Site incharge
	2 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 and validity of BIS license to be ensured.	Contractor	As proposed by Contractor	Material shall be supplied from producers / authorized dealers.	Site In-charge
		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	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

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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
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					their notified dealers / new vendors, frequency testing of 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).	samples to be witnessed. ##	
		<p>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 &amp; 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).</p>					
	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	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per 200 cum or part thereof, Samples to be tested by Contractor in POWERGRID approved lab.	100% review of lab test results.	Site In-charge
	4. Fine aggregate	1. Source approval	Source 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.

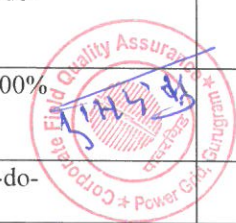


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		2. Physical test	As per Annexure-4 of this FQP	Samples to be taken jointly and tested in POWERGRID accepted lab	One sample per 200 cum or part thereof, Samples to be tested by Contractor in POWERGRID approved lab.	100% review of lab test results	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 value not less than 6	Site Engineer
	B. Concrete Works A) Before concreting of piles	1. Check for center line of each pile	Construction Drawings	Contractor	100%	100%	Site Incharge.
		2. Check for dia & verticality of each pile	-do-	-do-	-do-	-do-	-do-
		3. Check for depth of each pile	-do-	-do-	-do-	-do-	-do-
		4. Diameter of borehole	-do-	-do-	-do-	-do-	-do-
		5. Cut off & Founding level of each pile	-do-	-do-	-do-	-do-	-do-
		6 Sp. Gravity of bentonite slurry	As per IS 2911(Part-1/Sec. 2)-reaffirmed 2020	Contractor	100%	100%	Site Incharge.
		7. Placement of reinforcement steel	Bar bending schedule of construction	-do-	-do-	-do-	-do-



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		and its cover.	drawing				
		8. 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-
	B) Design Mix	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 this FQP.	-do-	-do-	Site In charge in consultation with Regional engineering department
	C) During concreting a) Workability	1. Slump test	150 – 180 mm as per POWERGRID Spec.	Contractor	Minimum Two per day per location, preferably one at the start of concreting	100% at field	Site In-charge.
		2. Use of admixtures in concreting both in nominal and design mix	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	Contractor	Use as per IS 9103:1999 (Reaffirmed 2018) to achieve workability.	100% at field Site Engineer	Site In-charge.



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			Engineers in Charge.				
	b) 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 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	One sample of 3 cubes for every 20 cum or part thereof for pile, pile caps, beams, chimney.  Concrete Cube collection & testing in case of RMC:  Ready Mix Concrete (RMC) 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: 4926:2003 (Reaffirmed 2022). The raw material in the RMC bins must be from approved sources/ brands make.	a) 100% cubes for piles, Pile caps, beams, chimney etc. to be taken in presence of POWERGRID officials. b) 100% review of test results. 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.  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. In-case of Site/POWERGRID Lab, 100% witness by POWERGRID Representative
	c) Consumption of Concrete Volume	Rate of concreting w.r.t. length of built up pile	Theoretical Volume (Actual volume should be greater than theoretical volume)	Contractor.	Every Pile	100% 	Site Engineer
	d) Use of PVC Block in place of Concrete Cover	PVC cover blocks may be used as an	IS 456:2000 (Reaffirmed 2021)	Contractor	100 %	100% 	Site Engineer

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	Blocks:	alternative to concrete cover blocks as per clause no.12.3.2 of IS 456					
	C)Before concreting of pile caps & Pedestal						
	a) Bottom of excavated earth	Depth of foundation	Approved Drawings	Contractor	100% at Field	100% check by POWERGRID	Site In-charge
	b) Chipping of Pile head	i) Removal of loose Material	As per Specification & IS:2911 (Part 1/Section 2): 2020	Contractor	100%	100%	Site In-charge
		ii) Exposure of reinforcement steel	As per Specification & IS:2911 (Part 1/Section 2): 2020	Contractor	100%	100%	Site In-charge
		iii) Cut off Level of Pile	As per construction drawings	Contractor	100%	100%	Site In-charge.
	c) Stub/Anchor bolt setting	1) Centre Line	-do-	-do-	-do-	-do-	-do-
		2) Diagonals	As per construction drawings	Contractor	100%-	100%	Site In-Charge
		3) Level of stubs/Anchor plates	-do-	-do-	-do-	-do-	-do-
	d) Reinforcement	Placement of reinforcement steel & its cover	Bar bending schedule of construction drawing	-do-	-do-	-do-	-do-
	D) P.C.C. (Grade, Thickness &	completeness	IS 456 and POWERGRID approved foundation	Joint Inspection by POWERGRID	For all locations	Joint Inspection by POWERGRID and CONTRACTOR	Site In-charge.

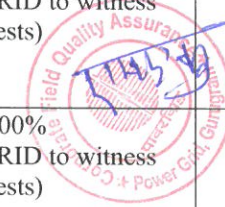


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	Size)		drawings & specification	and CONTRACTOR			
	E. Membrane Curing	In addition to the moist curing of casted concrete structures, membrane curing can also be used as per IS 456: 2000(Reaffirmed 2021) Cl. no. 13.5.2	IS 456: 2000(Reaffirmed 2021)and as per Specification/Manufacturer's catalogue	Contractor	100%	100%	Site Engineer
3.	NDT/Core Tests	UPV and Rebound Hammer /Core test	<p><b>Refer POWERGRID's Standard procedure for Testing/Assessment of compressive strength of casted Concrete, revision-I as per Annexure-8</b></p> <p><b>## Accepting Authority:</b></p> <p>(i) For NDT/Core tests results, if not meeting the acceptance criteria, Regional Head is the Accepting Authority.</p> <p>(ii) CGM (Projects) will be the accepting authority for NDT (UPV &amp; 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</p>				##
4.	Pile Load testing	a) Initial Test	IS:2911 (Part-4)-2018	Contractor (By POWERGRID approved Testing agency)	As per IS:2911 (Part-4)-2018	100% (POWERGRID to witness tests)	Site In-charge
		b) Routine Test	IS:2911 (Part-4)-2018	Contractor (By POWERGRID approved Testing agency)	As per IS:2911 (Part-4)-2018	100% (POWERGRID to witness tests)	Site In-charge



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**ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT**

<b>ORDINARY PORTLAND CEMENT</b>					
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)	<b>Physical tests</b>				To be conducted in Appd. Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 cm <sup>2</sup> per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm <sup>2</sup> per gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 cm <sup>2</sup> 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/mm <sup>2</sup> )  168 ± 2 hour : Not less than 22 Mpa (22 N/mm <sup>2</sup> )  672 ± 4 hour : Not less than 33 Mpa (33 N/mm <sup>2</sup> ), Not more than 48Mpa (48N/mm <sup>2</sup> )	72 ± 1 hour : Not less than 23 Mpa ( 23 N/mm <sup>2</sup> )  168 ± 2 hour : Not less than 33Mpa ( 33 N/mm <sup>2</sup> )  672 ± 4 hour : Not less than 43 Mpa ( 43 N/mm <sup>2</sup> ), Not more than 58Mpa (58N/mm <sup>2</sup> )	72 ± 1 hour : Not less than 27Mpa (27 N/mm <sup>2</sup> )  168 ± 1 hour : Not less than 37Mpa ( 37 N/mm <sup>2</sup> )  672 ± 1 hour : Not less than 53 Mpa ( 53 N/mm <sup>2</sup> )	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.



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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)	<b>Chemical composition tests</b>				Review of MTCC 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. <b>5.00%</b>	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 <sub>3</sub> ), percentage by mass not more than 3.5%	e) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass not more than 3.5%	e) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass not more than 3.5%	
		f) Total loss on ignition - Not more than 5 percent	f) Total loss on ignition - Not more than 5 percent	f) Total loss on ignition - Not 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.	<b>POZZOLANA PORTLAND CEMENT AS PER IS 1489 (Part 1) Reaffirmed 2020</b>	
a)	<b>Physical tests</b>	
	i) Fineness	Specific surface area shall not be less than 300 sq.m. per Kg. or 3000 Cm <sup>2</sup> /gm
	ii) Compressive strength	a) 72 ± 1 hour : Not less than 16 Mpa (16 N/mm <sup>2</sup> ) b) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm <sup>2</sup> ) c) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm <sup>2</sup> )
	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)	<b>Chemical composition tests</b>	
	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 <sub>3</sub> ), percentage by mass not more than 3.0-3.5	-do-
	d) Total loss on ignition - Not more than 5 percent	
	e) Chloride content, percent by mass, max 0.1%	



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**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)	<b>Chemical analysis test</b>				
	Carbon	<b>0.30 Percent Maximum</b>	<b>0.25 Percent Maximum</b>	<b>0.30 Percent Maximum</b>	<b>0.25 Percent Maximum</b>
	Sulphur	<b>0.055 Percent Maximum</b>	<b>0.040 Percent Maximum</b>	<b>0.055 Percent Maximum</b>	<b>0.040 Percent Maximum</b>
	Phosphorus	<b>0.055 Percent Maximum</b>	<b>0.040 Percent Maximum</b>	<b>0.055 Percent Maximum</b>	<b>0.040 Percent Maximum</b>
	Sulphur & Phosphorus	<b>0.105 Percent Maximum</b>	<b>0.075 Percent Maximum</b>	<b>0.10 Percent Maximum</b>	<b>0.075 Percent Maximum</b>
	Carbon Equivalent	<b>0.42 percent Maximum</b>	<b>0.50 percent Maximum</b>	<b>0.50 percent Maximum</b>	<b>0.61 percent Maximum</b>
ii)	<b>Physical tests</b>				
	a) Tensile Strength/Yield stress ratio,	$\geq 1.08$ , but tensile strength not less than 545.0 N/mm <sup>2</sup>	$\geq 1.10$ , but tensile strength not less than 565.0 N/mm <sup>2</sup>	$\geq 1.06$ , but tensile strength not less than 585.0 N/mm <sup>2</sup>	$\geq 1.08$ , but tensile strength not less than 600.0 N/mm <sup>2</sup>
	b) 0.2% of proof stress/Yield stress Minimum, N/mm <sup>2</sup>	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)	<b>Bend &amp; Rebend tests</b>	Pass	Pass	Pass	Pass



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Annexure-3

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

<b>3.</b>	<b>Coarse Aggregates</b>										
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 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)	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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**ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383:2016 (Reaffirmed 2021)**

<b>4.</b>	<b>Fine aggregates</b>				
i)	Physical Tests	<b>IS Sieve Designation</b>	<b>Percentage passing for graded aggregate of nominal size</b>		
a)	Determination of particle size		<b>F.A. Zone I</b>	<b>F.A. Zone II</b>	<b>F.A. Zone III</b>
		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	<b>0-10</b>
b)	Presence of deleterious material	<b>Total presence of deleterious materials not to exceed 5% for uncrushed, 2% for crushed/Mixed and manufactured fine aggregates as per annexure- 4A.</b>			
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 sands, the permissible limit on 150 micron IS Sieve is increased to 20 percent.



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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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**ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CONCRETE WORK**

1)	<b>Concrete</b>	a) Workability	Slump shall be recorded by slump cone method and it shall be between 150 - 180 mm.
		b) Compressive strength	For Design mix as per IS 456:2021 for Grade M15 or above

**Notes:**

- All Design Mix concrete shall be as per IS 456:2021. In case of piles subsequently exposed to free water or in case of piles where concreting is done under water or drilling mud using methods other than the tremie, 10% extra cement over that required for the design grade of concrete at the specified slump shall be used subject to minimum quantity of cement specified above.
- 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/mm <sup>2</sup>	Individual Test Results in N/mm <sup>2</sup>
	Min (2)	Min (3)
M 15 and above	$\geq f_{ck} + 0.825 \times \text{established standard deviation}$ (rounded off to nearest 0.5 N/mm <sup>2</sup> ) or $f_{ck} + 3 \text{ N/mm}^2$ , whichever is greater	$\geq f_{ck} - 3 \text{ N/mm}^2$

**NOTES**

- 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.
- For concrete of quantity up to 30 m<sup>3</sup> (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  $f_{ck} + 4 \text{ N/mm}^2$ , minimum and the requirement of minimum individual test results shall be  $f_{ck} - 2 \text{ N/mm}^2$ , minimum. However, when the number of sample is only one as per 15.2.2, the requirement shall be  $f_{ck} + 4 \text{ N/mm}^2$ , minimum.



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- 3) 53 Grade cement shall be used after obtaining specific approval of the Engineer in charge.
- 4) Portland slag cement conforming to IS 455:2015 (Reaffirmed 2020) may be used as per Technical Specification.
- 5) 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.

### 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 Engr means incharge 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.
- 11) Mobile testing Labs owned by the contractor may also be acceptable if their facilities meet the testing requirements and the testing equipments are properly calibrated at Third Party Labs where testing/calibration is to be carried out should be accredited by NABL or an agency operating in line with ISO/IEC 17011 and having full membership & MRA of ILAC/APLAC, subject to approval of project Incharge.
- 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 2022) i.e.**
  - i) Information to be supplied by the purchaser (clause 7)



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**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 456:2021.**

- 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) 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) Standard marking of ISI mark along with license number (Seven digit no., represented as CM/L-----) should be verified for construction materials.
- 19) 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.
- 20) 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.
- 21) Digital Photographs during major construction activities shall be taken and kept in record.
- 22) All the charges in connection with NDT/ Core tests shall be borne by the contractor.
- 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) The preference shall be given to concrete batching plant/RMC plants approved by Quality Council of India.
- 25) Wherever reference to BIS Codes is made, it shall be the latest edition/revision of the same.



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### 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:

- a) Soil investigation report should contain the bore Log sheet indicating the variation of different soil strata.
- b) The Bearing capacity, Bulk density ( $\gamma$ ), Submerged Density ( $\gamma_{sub}$ ), angle of repose ( $\delta$ ) in dry as well as wet condition and Angle of internal friction ( $\phi$ ) 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 ( $\delta$ ) in line with parameters indicated in the standard foundation drawings.
- e) If Rock is encountered prior to termination of bore hole, 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.
- f) Liquefaction Potential Analysis should be included in the report (for seismic zone-3 and above only) and recommendation of possible remedial measures shall be provided.



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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 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2.	Type of Concrete- Structural Classification	PCC   RCC   PSC   Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3.	Placing Conditions of Concrete (Structural Elements)	Building   TL Pile   S/S Pile   S/S Structure   Road <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
B 4.	MIX DESIGN LIMITS: Max. Water-Cement Ratio (W/C)- Optional	0.30   0.35   0.40   0.45   0.50   Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5.	Min Cement Content- Optional- Kg/m3	300   320   340   360   380   Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
C 6.	EXPOSURE CONDITIONS: @ Type of Environmental Exposure	Mild   Mod.   Severe   V. Severe   Extreme <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
7.	Whether Exposed to Sulphate attack from Soil, Water & Containment.	Yes   No   Not Known <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
8.	Whether Exposed to Chloride attack from Soil, Water & Containment.	Yes   No   Not Known <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
D 9.	CONCRETE INGREDIENTS: Source of Water for Construction	Ground   River   Pond   Others <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>



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10.	Type of Cement & Strength Grade.	OPC Gr.33 <input type="checkbox"/> OPC Gr.43 <input type="checkbox"/> OPC Gr.53 <input type="checkbox"/> PPC BFS <input type="checkbox"/> PPC FAB <input type="checkbox"/> PSC <input type="checkbox"/>
11.	Brand, Batch No./Week/Year of Cement (Test Certificate to be sent to Lab)	<input type="text"/> <input type="text"/>
12.	Cementitious Materials Proposed for Improvement of Density & Permeability.	Microsilica/Silica Fume <input type="checkbox"/> Slag <input type="checkbox"/> Fly Ash <input type="checkbox"/> Other Pozzolona <input type="checkbox"/>
13.	FRESH CONCRETE Properties: Desired Slump of Concrete (mm)#	25-55 <input type="checkbox"/> 25-75 <input type="checkbox"/> 100-150 <input type="checkbox"/> Others <input type="checkbox"/>
14.	QUALITY CONTROL AT SITE: Degree of Quality Control at Project Site (For Standard Deviation)	V. Good <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Std.Lab. <input type="checkbox"/>
15.	Max. Size of Coarse Aggregate (MSA)-mm	63 <input type="checkbox"/> 40 <input type="checkbox"/> 20 <input type="checkbox"/> 12.5 <input type="checkbox"/> 4.75 <input type="checkbox"/> Other <input type="checkbox"/>
16.	Source of Coarse Aggregate	Name of Quarry                      Location
17.	Type of Fine Aggregate	River Sand <input type="checkbox"/> Crushed Sand <input type="checkbox"/> Others, Specify <input type="checkbox"/>
18.	Source of Fine Aggregate (Sand)	Name of Quarry:                      Location:



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19.	Admixture proposed to be Used (Batch MTC to be Submitted to Lab)	Brand Name:	Batch No.:
20.	Type of Compaction Equipment	Plate Vibrator <input type="checkbox"/> Needle Vibrator <input type="checkbox"/> Vibro Hyd. Pressure <input type="checkbox"/> Piling Concrete <input type="checkbox"/>	
21.	Type of Concrete Placement Facility at Project	Manual Lift <input type="checkbox"/> Hydraulic Bucket <input type="checkbox"/> Concrete Pump <input type="checkbox"/>	
22	Maximum/Minimum temp. envisaged during placing of concrete		

# 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



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@EXPOSURE CONDITIONS

ENVIRONMENT	EXPOSURE CONDITIONS
MILD	<ul style="list-style-type: none"> <li>• Concrete surfaces protected against weather or aggressive</li> </ul>
MODERATE	<ul style="list-style-type: none"> <li>• Concrete exposed to condensation and rain</li> <li>• Concrete continuously under water</li> <li>• Concrete surfaces sheltered from rain or freezing whilst wet</li> <li>• Concrete in contact or buried under non-aggressive soil/ground water</li> </ul>
SEVERE	<ul style="list-style-type: none"> <li>• Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation</li> <li>• Concrete completely immersed in sea water</li> <li>• Concrete exposed to coastal environment</li> </ul>
VERY SEVERE	<ul style="list-style-type: none"> <li>• Concrete surfaces exposed to sea water spray, corrosive fumes or severe freezing conditions whilst wet.</li> <li>• Concrete in contact with or buried under aggressive subsoil/ ground water</li> </ul>
EXTREME	<ul style="list-style-type: none"> <li>• Surface of members in tidal zone, Members in direct contact with liquid/solid aggressive chemicals</li> </ul>



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**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**



पावर ग्रिड कॉर्पोरेशन आफ इंडिया लिमिटेड  
कारपोरेट एफ. क्यू.ए. विभाग  
अंतर कार्यालय 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)

एम अशोक कुमार  
05/07/2024  
(एम अशोक कुमार)

**वितरण/Distribution:**

- 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 प्रोजेक्ट्स./टी.बी.सी.बी./ उप मुख्य सतर्कता अधिकारी/संविदा सेवाए/ अभियांत्रिकी /अभियांत्रिकी एच वी डी सी / एफ. क्यू.ए.
- ES/PS of CMD/Director (Projects)/Director (Operation)/Director (Fin)/CVO
- 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:  
 $\geq f_{ck} + 0.825 \times$  established standard deviation (rounded off to nearest 0.5 N/mm<sup>2</sup>)  
or  
 $f_{ck} + 3$  N/mm<sup>2</sup>

whichever is greater for M 15 and above and Individual test results minimum  $\geq f_{ck}-3$  N/mm<sup>2</sup>

### 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 m<sup>3</sup> (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  $f_{ck}+4$  N/mm<sup>2</sup>, minimum and the requirement of minimum individuals test results shall be  $f_{ck}-2$  N/mm<sup>2</sup>, minimum. However, when number of sample is only one as per 15.2.2 IS 456:2000, the requirement shall be  $f_{ck}+4$  N/mm<sup>2</sup>, minimum.

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

- b) when compressive strength value is in between  $f_{ck}$  and  $f_{ck}+4/f_{ck}+3$  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  $f_{ck}$  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.

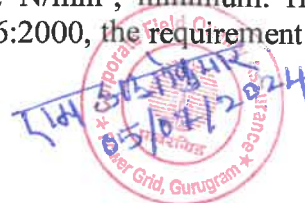
## 2.2 Payment procedure (Other than Pile) in case of Design Mix: Concrete Cubes

- a) when mean of the group of four (4) non overlapping consecutive test results:  
 $\geq fck + 0.825 \times \text{established standard deviation (rounded off to nearest } 0.5 \text{ N/mm}^2)$   
 or  
 $fck + 3 \text{ N/mm}^2$

whichever is greater for M 15 and above and Individual test results minimum  $\geq fck-3 \text{ N/mm}^2$

### 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 m<sup>3</sup> (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  $fck+4 \text{ N/mm}^2$ , minimum and the requirement of minimum individuals test results shall be  $fck-2 \text{ N/mm}^2$ , minimum. However, when number of sample is only one as per 15.2.2 IS 456:2000, the requirement shall be  $fck+4 \text{ N/mm}^2$ , minimum.



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

- b) when compressive strength value is in between  $f_{ck}$  and  $f_{ck}+4/f_{ck}+3$  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  $f_{ck}$  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  $f_{ck}$ , 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  $f_{ck}+4/f_{ck}+3$  as applicable, then full payment shall be made.
- ii) When equivalent cube strength is in between  $f_{ck}$  and  $f_{ck}+4/f_{ck}+3$  as applicable/When equivalent cube strength is in between 85%  $f_{ck}$  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.

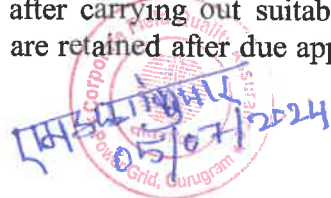
If structures are retained after strengthening/ rectification measures, All the charges in connection with these additional tests and /or strengthening / rectification work shall be borne by the contractor.

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  $fck+0.825 \times \text{Standard Deviation}$  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  $fck+0.825 \times \text{Standard Deviation}$  or  $fck+4/fck+3$  as applicable which ever greater, then payment shall be released on prorata 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



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 applicable for 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.

