

SECTION - 3

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**North Eastern Electric Power Corporation Ltd
(A Government of India Enterprise)**

**Techno-Commercial Specifications
for
Tripura Gas Based Power Project
(100 ± 20MW): MONARCHAK: TRIPURA**

VOLUME 3: PART – E

**PARTICULAR TECHNICAL SPECIFICATION
(CIVIL WORKS)**

April'2009

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Clause No.	EXCAVATION AND FILLING
1.00.00	SCOPE
1.01.00	This section of the specification covers the technical requirements for excavation and filling in and around structures, buildings, pipes, foundations, trenches, pits, drains, channels, cable ducts, underground facilities and similar works. It also covers filling areas and plinths with selected materials, conveyance and disposal of surplus spoils and/or stacking them properly as directed by the Engineer-in-Charge.
1.02.00	The Contractor shall be fully responsible for proper setting out of works, profiling in excavation, stacking, etc., taking adequate safety measures etc. The Contractor shall carry out all works meant within the intent of this specification even if not explicitly mentioned herein. All work shall be executed to the satisfaction of the Engineer-in-Charge.
1.03.00	Existing trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, drains sewers, or other surface or subsurface systems/drains/facilities within or adjacent to the works being carried out which are not to be disturbed; shall be protected from damage by the contractor. The Contractor shall provide and install suitable safeguards approved by the Engineer-in-Charge for this purpose.
1.04.00	During excavation, the Contractor shall take all necessary precautions against soil erosion, water and environmental pollution, and where required undertake additional works to achieve this objective. Before start of operations, the Contractor shall submit to the Engineer-in-Charge for approval, his work plan and the procedure he intends to follow for disposal of waste materials etc., and the schedule for carrying out temporary and permanent control works. However, the approval of the Engineer-in-Charge to such plans and procedures shall not absolve the Contractor of his responsibility for safe and sound work.
2.00.00	GENERAL REQUIREMENTS
2.01.00	The Contractor shall make his own surveying arrangements for locating the coordinates and positions of all work and establishing the reduced levels (RL's) at these locations based on two reference grid lines and one bench mark which will be furnished by the Owner. The Contractor has to provide at site all the required survey instruments, along with qualified surveyors, to the satisfaction of the Engineer-in-Charge so that work can be carried out accurately and according to the specification and drawings.
2.02.00	The Contractor shall furnish all skilled and unskilled labour, plant, tools, equipment, men, materials, required for complete execution of the work in accordance with the drawings and as described herein and/or as directed by the Engineer-in-Charge.
2.03.00	The Contractor shall control the ground in the vicinity of all excavations so that the surface of the ground will be properly sloped or dyked to prevent surface water from running into the excavated areas during construction.

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Clause No.	EXCAVATION AND FILLING
2.04.00	All materials obtained from excavation shall remain owner's property. All salvaged materials of archaeological importance or of value (in the opinion of the Engineer-in-Charge) shall be segregated from the other materials and both stacked separately and in a regular manner at locations indicated by the Engineer-in-Charge.
2.05.00	Excavation shall include the removal of trees including roots and organic remains, vegetation, grass, bushes, shrubs, plants, poles, fences, etc. that are in the area to be excavated as well as beyond the excavation line so as to ensure safety of the excavated side slopes, and of men and equipment operating in the area. Before start of excavation work, joint measurements of ground level shall be taken after cleaning all grass, vegetation, etc.
2.06.00	Excavation shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance as decided by the Engineer-in-Charge to permit the placing and setting of forms, inspection and completion of all works to the satisfaction of the Engineer-in-Charge for which the excavation was done.
3.00.00	CODES AND STANDARDS
3.01.00	All standards, specifications, acts, and codes of practice referred to herein shall be latest editions including all applicable official amendments and revisions.
3.02.00	In case of conflict between this specification and those (IS standards, codes etc.) referred to herein (in para 3.03) the stringent of the two shall prevail.
3.03.00	Some of the relevant Indian Standards, Act and Codes are referred to here below :
IS : 383	: Specification for coarse and fine aggregates from natural sources for concrete.
IS : 1200 (Part-I)	: Method of Measurement of building and civil engineering work -earthwork.
IS : 2720 (Part-II, IV to VIII, XIV, XXI, XXIII, XXIV, XXVII to XXIX, XL)	: Methods of test for soils-determination of water content etc.
IS : 3764	: Safety code for excavation work.
IS : 4081	: Safety code for blasting and related drilling operations.
IS : 4701	: Code of practice for earth work on canals.
IS : 9758	: Guide lines for dewatering during construction.
IS : 10379	: Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.
Indian Explosives Act 1940	: As updated

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Clause No.	EXCAVATION AND FILLING
4.00.00	CLASSIFICATION
	For purposes of work to be executed in accordance with this specification, the following classification only shall apply. In case of any dispute regarding classification of materials excavated/ filled, the decision of the Engineer-in-Charge shall be final and binding on the contractor.
4.01.00	Soil
	<ul style="list-style-type: none"> a) This shall include all types of soils which can be excavated by pick axes or spades or earth moving equipment such as shovels, draglines, etc. b) It shall include, but not be limited to, vegetable or organic solid, turf, sand, silt, mud, moorum, shingle, clay, gravel, loam, macadam, peat, shale, ash, marsh, bricks, tar/bitumen surfaces, lime concrete, stone/brick masonry etc. It shall also include embedded rocks, boulders not longer than one metre and not more than 300mm in any one of the other two directions.
5.00.00	EXCAVATION IN SOIL
5.01.00	Sides and bottoms of excavation shall be cut sharp and true to line and level. Undercutting shall not be permitted. When machines are used for excavation, the last 300 mm before reaching the required level shall be excavated manually or by such equipment that soil at the required final level will be left in its natural condition. Suitability of strata (at the bottom of excavations) for laying the foundation thereon shall be determined by the Engineer-in-Charge.
5.02.00	Excavation for foundations shall be to the bottom of lean concrete and as shown on drawings or as directed by the Engineer-in-Charge. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels, by error, it shall be brought back to specified level by filling with concrete of nominal mix 1:4:8 (cement : coarse sand : 40mm down aggregates) as directed by the Engineer-in-Charge.
5.03.00	The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Coffers, sheet piling, sheeting, shoring, bracing, maintaining suitable slopes, draining etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer-in-Charge.
5.04.00	When excavation requires bracing, sheeting or shoring etc. the Contractor shall submit drawings to the Engineer-in-Charge, showing arrangements and details of proposed installation. The contractor shall also furnish all supporting calculations as called for and shall not proceed until he has received written approval from the Engineer-in-Charge. However, the responsibility for adequacy of such bracing, sheeting, shoring etc., will rest with the Contractor, irrespective of any approval of the Engineer-in-Charge.
5.05.00	The Contractor shall have to constantly pump out any water collected in excavated pits

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	and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. The Contractor shall remove all slush/muck from the excavation areas to keep the work area dry. Sludge pumps, if required, shall be employed by the Contractor for this purpose.
5.06.00	The Contractor shall remove all materials arising from excavations from the vicinity of the work either for direct filling, stacking and subsequent filling or for ultimate disposal as directed by the Engineer-in-Charge. In no case shall the excavated soil be stacked within a distance of 1.5m from the edge of excavation or one-third the depth of excavation whichever is more. Material to be used for filling shall be kept separately.
6.00.00	EXCAVATION BELOW GROUND WATER TABLE
6.01.00	Wherever ground water table is met with during excavation, the Contractor shall immediately report this fact to the Engineer-in-Charge who shall arrange to record the exact level of the water table before start of dewatering operation. The decision of the Engineer-in-Charge regarding sub-soil water level shall be final and payable provided the Contractor has made arrangement for its dewatering. Ground water table for the purpose of this clause shall be taken as the level of standing water observed during the process of excavation. Capillary action of water in the surrounding soil mass shall not be considered for the above purpose.
6.02.00	The Contractor shall dewater and maintain dry working conditions by maintaining the water table below the bottom of the excavation level by well point dewatering or deep well dewatering or any other method approved by the Engineer-in-Charge. He shall continue doing so till excavation, concreting, curing, and all other operations included in the scope of work, which require dry condition in the area, are completed.
7.00.00	LIFT
	The Contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer-in-Charge. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer-in-Charge.
8.00.00	CARRIAGE OF EXCAVATED MATERIALS
8.01.00	The contractor shall arrange to transport the surplus excavated soil for all lead if so directed by the Engineer-in-Charge. The soil so transported shall be stacked and levelled neatly and dressed.
9.00.00	BACKFILLING AROUND FOUNDATIONS IN PITS, TRENCHES, PLINTH OR UNDER FLOORS
9.01.00	Earth
	Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Materials for backfilling shall generally be obtained

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	<p>from the spoil of excavation. But the Engineer-in-Charge shall have the option, In case of shortage of good selected earth obtained from excavation, to direct the contractor to get the filling materials from approved borrow pits at no extra cost to the owner.</p>
9.02.00	<p>Filling in pits and Trenches around Structure</p> <p>As soon as the work in foundations has been accepted, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc. and filled with earth in layers not exceeding 20 cm each layer being watered, rammed and properly consolidated before the next layer is laid. Each layer shall be compacted to the satisfaction of the Engineer-in-Charge. Earth shall be rammed and properly consolidated before the next layer in bid. Each layer shall be compacted to the satisfaction of the Engineer-in-Charge. Earth shall be rammed preferably with approved compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer-in-Charge. The final surface shall be trimmed and levelled to proper profile as desired by the Engineer-in-Charge.</p>
9.03.00	<p>Plinth Filling</p> <p>The Plinth shall be similarly filled with earth as described herein before, in layers not exceeding 20 cm, watered and compacted with approved compaction machine or manually if specifically permitted by the Engineer-in-Charge. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and consolidated, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be provided to the floor.</p>
9.04.00	<p>Backfilling Excavated Earth in Trenches for Pipes and Drains</p>
9.04.01	<p>General</p> <p>Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where the excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 20 cm size in any direction, mixed with fine material consisting of decomposed rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. Before backfilling is commenced, the Engineer-in-Charge should be shown the foundation for approval. In case of water retaining structure, and pipes, the water tightness testing shall be carried out as per IS codes and remedial measures implemented in case of any leakage/seepage. The backfilling in all cases shall be done in layers of not exceeding 20 cm with proper ramming and watering to achieve minimum 90% modified proctor's density or as stipulated in the drawing. Backfilling will be done with approved earth from excavation. Where sufficient suitable earth is not available from excavation the Engineer-in-Charge may direct to import sufficient earth from different outside sources as called for.</p> <p>The contractor shall control grading of all excavations in the area so that surface of ground will be properly sloped to prevent surface water from flowing into the excavated area during construction. The contractor shall take necessary precautions to ensure that safety of the dewatering purposes shall be disposed off by the contractor in the nearby existing drain as per instructions of the Engineer-in-Charge without any extra</p>

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	cost.
9.04.02	<p>Filling of Trenches</p> <p>Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm, watered and rammed and compacted taking care that no damage is caused to the pipe below.</p>
9.05.00	<p>Sand filling in plinth and below foundations</p> <p>Minimum depth of sand filling to be provided is 300mm above earth level. The backfilling shall be done with local sand if directed by the Engineer-in-Charge. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept immersed in water for sufficient time to ensure compaction. If so directed by the Engineer-in-Charge, maximum compaction shall be achieved by filling in water and dumping sand in water till the required level is reached, then the water shall be drained out. The surface of the consolidated sand shall be dressed to required level & slope. Construction of floors or foundations on sand fill shall not be started until the Engineer-in-Charge has inspected and approved the fill.</p>
9.06.00	<p>Earth Filling</p> <p>Earth filling over the required areas as per the approved drawings and to the directions of the Engineer-in-Charge shall be carried out to the specified grade, levels or to the levels necessary according to the needs of the Bidder's equipment. Earth required for the filling work shall be brought from approved borrows pits from outside the plant area as per directions of the Engineer-in-Charge. The bidder shall arrange by himself to get the required earth from outside the plant area at no extra cost to the owner. The selection of the nature of soil obtained from borrow pits shall be approved by the Engineer-in-Charge.</p> <p>The filling operation shall consist of laying the earth in layers of 20cm thick each, compacting it by rolling with sheep foot rollers etc. of approved tonnage and plying to required number of passes at the optimum moisture content of the soil. The soil thus compacted should give at least 90% of maximum dry density of soil. Tests for compaction are to be performed as per the procedure laid down in the relevant IS codes of practice. The compaction tests shall be performed by the Bidder at his own cost.</p>
10.00.00	<p>COMPACTION</p> <p>a) Where compaction to 85% Standard Proctor Density is called for, such compaction shall be by mechanical means but the Contractor may be permitted to adopt manual means only if the Engineer-in-Charge finds that the desired compaction is achievable in the field.</p> <p>b) Where compaction to 95% Standard Proctor Density is called for, it shall be by mechanical means only. Where access is possible, compaction shall be by 12 tonne rollers smooth wheeled, sheep foot or wobbly wheeled as directed by the</p>

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Clause No.	EXCAVATION AND FILLING
	<p>Engineer-in-Charge. A smaller weight roller may be permitted by the Engineer-in-Charge in special cases, but in any case not less than 10 passes of the roller will be accepted for each layer. Each layer shall be wetted or the material dried by aeration to a moisture content of 3-5% above the Optimum Moisture Content to be determined by the Contractor.</p> <p>c) For compacting each sand layer, water shall be sprayed over it to flood it and it shall be kept flooded for 24 hours to ensure maximum compaction. Vibro-compactors shall also be used if necessary to obtain the required degree of compaction. Any temporary works required to contain sand under flooded condition shall also be undertaken. The surface of the consolidated sand shall be dressed to required levels or slope.</p> <p>d) After the compacted fill has reached the desired level, the surface shall be flooded with water for 24 hours, allowed to dry and then rammed and consolidated to avoid any settlement, at a later date. The compacted surface shall be properly shaped, trimmed and consolidated to an even gradient or level. All soft spots shall be excavated, filled and consolidated.</p> <p>e) The degree of compaction of compacted fill in place will be subject to tests by the Engineer-in-Charge as the work progresses, and the Contractor shall provide the necessary facilities to make such tests. If any test indicates that the compaction achieved is less than the specified degree of compaction, the Engineer-in-Charge may require all fill placed subsequent to the last successful test to be removed and re-compacted by the Contractor. Compaction procedure shall be amended as necessary to obtain satisfactory results.</p> <p>f) When semi-compacted fill is specified by the Engineer-in-Charge the Contractor shall fill-up such areas with available earth from stock piles or borrow pits or directly from excavation without special compaction except that obtained by moving trucks, etc.</p>
11.00.00	SAMPLING TESTING AND QUALITY CONTROL
11.01.00	General
	<p>a) The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and/or International Standards and shall conduct such tests as are called for by the Engineer-in-Charge. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer-in-Charge. Tests shall be done in the field and at a laboratory approved by the Engineer-in-Charge and the Contractor shall submit to the Engineer-in-Charge, the test results in triplicate within three days after completion of a test. The Engineer-in-Charge may, at his discretion, waive some of the stipulations given below, for small and unimportant operations.</p> <p>b) Work found unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per specification requirement and to the satisfaction of the Engineer-in-Charge.</p> <p>c) Only as a very special case and that too in non-critical areas, the Engineer-in-</p>

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Clause No.	EXCAVATION AND FILLING
	<p>Charge may accept filling work which is marginally unacceptable as per the criteria laid down.</p>
11.02.00	<p>Quality Assurance Programme</p> <p>The Contractor shall submit and finalise a detailed filed Quality Assurance Programme within 30 days from the date of award of the Contract according to the requirements of the specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/ experienced manpower, preparation of format for record, field quality plan etc. On finalised field quality plan the Owner shall identify customer hold points beyond which work shall not proceed without written approval from the Engineer-in-Charge.</p>
11.03.00	<p>Frequency of sampling and testing including the methods for conducting the tests are given in Table-I. The testing frequencies set forth are the desirable minimum and the Engineer-in-Charge shall have the full authority to carry out or call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications.</p>
11.04.00	<p>Acceptance Criteria</p> <p>Following Acceptance Criteria shall be followed :</p> <ol style="list-style-type: none"> All individual samples collected and tested should pass without any deviation when only one set of sample is tested. For re-test of any sample two additional samples shall be collected and tested, and both should pass without any deviation. Where a large number of samples are tested for a particular test than 9 samples out of every 10 consecutive samples tested shall meet the specification requirement. Tolerance on finished levels for important filling areas at approved interval shall be +20mm. However, for an un-important area, tolerance upto +75mm shall be acceptable at the discretion of the Engineer-in-Charge. However, these tolerances shall be applicable for localised areas only.

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Clause No.

EXCAVATION AND FILLING

TABLE-I

FREQUENCY OF SAMPLING AND TESTING

Sl. No.	Type of material/work	Nature of Test/ characteristics	Method of Test	No. of Samples and frequency of test	Remarks/ Acceptance norms
I.	Burnt clay bricks	a) Dimensions	Clause No. 5.2.1 of IS:1077		Max. 8% deviation for non-modular bricks. For modular bricks as per clause No. 5.2 of IS: 1077. For face bricks as per IS:2691
		b) Compressive strength	IS:3495 (Part-1)	As specified	
		c) Water absorption	IS:3495 (Part-2)	A set of 20bricks (min) for each lot of 50,000 or part thereof for all tests (a to e)	Max. 20%. However, 15% for face bricks only.
		d) Efflorescence	IS:3495 (Part-3)		Moderate. However for face brick nil.
		e) Warpage	IS:1123		For face brick 2.5mm (max.)
II.	Stone	a) Type of stone by petrographic examination	IS:1123	One set of stones of each type and from each source.	As specified.
		b) Shape and size	Physical measurement	Random	As specified.
		c) Crushing strength	IS:1121 (Part-1)	One set of stones of each type and from each source.	As specified.
		d) Water absorption	IS:1124	One set of stones of each type and from each source.	As specified.
		e) Durability	IS:1126	One set of stones of each type and from each source.	As specified.
III	Sand	a) General quality	Visual	One set of samples from each source of material per 100 cu.m. or part thereof.	As specified.
		b) Deleterious material	IS:2386 (Parts- 1&2)	One set of samples from each source of material per 100 cu.m. or part thereof.	Clause 3.3 of IS:2116
		c) Grading	Sieve analysis as per IS:2386 (Part-1)	One set of samples from each source of material per 100 cu.m. or part thereof.	Table-1 of IS:2116
IV.	Cement	a) Setting time	IS:4031	One set of sample for each lot of material received.	No separate testing is required in case cement is tested for preparation of concrete mix.

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Clause No. EXCAVATION AND FILLING

Sl. No.	Type of material/work	Nature of Test/ characteristics	Method of Test	No. of Samples and frequency of test	Remarks/ Acceptance norms
VI.	Water	b) Compressive strength	IS:4031	One set of sample for each lot of material received.	No separate testing is required in case cement is tested for preparation of concrete mix.
		a) Harmful substances, pH value	IS:3025	Once a month for each source.	No separate testing is required in case water tested for preparation of concrete mix.
VII.	Mortar	a) Compressive strength	Appendix-A of IS:2250	One sample (consisting of min 3 specimens)	Table-1 of IS:2250
		b) Consistency	Appendix-B of IS:2250	One sample for each type of mix.	Clause 7.2 of IS:2250
		c) Water Retentivity	Appendix-C of IS:2250	One sample for each type of mix.	Clause 7.3 of IS:2250
VIII.	Masonry construction	a) Workmanship	Visual and physical measurement.	All work	As per specification and Cl. No. 11.0 of IS: 2212 for brickwork.
		b) Verticality and alignment	Physical measurement.	All work	As per specification and Cl. No. 6.3.4 of IS: 1905.

MODULE - C3

Clause No.	PROPERTIES, STORAGES AND HANDLING OF COMMON BUILDING MATERIALS
1.00.00	SCOPE
1.01.00	The scope of this section of the specification is to specify the properties, storage and handling of common building materials, namely, coarse aggregates, cement, lime, water, sand, masonry units, reinforcement and structural steel.
1.02.00	Properties of the materials in general have been discussed. Specific requirements of the materials have been stipulated separately under specification for relevant items of work.
2.00.00	GENERAL REQUIREMENTS
2.01.00	The work shall include, providing of all necessary plants and equipment, providing adequate engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out the entire work as directed by the Engineer-in-Charge to his complete satisfaction.
2.02.00	<p>All materials proposed for use in the work shall conform to the requirements laid down in this section, and also subject to the approval of the Engineer-in-Charge. After specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-in-Charge.</p> <p>Approval of any material by the Engineer-in-Charge shall not relieve the Contractor of his responsibility, for the requisite quality and performance of the material used.</p>
2.03.00	Any material considered to be sub-standard, or not upto satisfaction of the Engineer-in-Charge, shall not be used by the Contractor and shall be removed from the site immediately.
2.04.00	Representative samples shall be procured by the Contractor and submitted to the Engineer-in-Charge, for approval before bulk procurement. The representative samples shall be retained by the Engineer-in-Charge for future comparison and reference.
2.05.00	Materials, which shall be issued by the Owner, shall be as specified elsewhere in the tender documents.
3.00.00	CODES AND STANDARDS
3.01.00	In the event that state, city or other local government bodies have requirements for stringent than those set forth in this specification, the former shall govern.
3.02.00	<p>All applicable standards, acts, specifications, codes of practice, hand book, referred to herein shall be the latest editions, including all official amendments and revisions. In case of discrepancy between this specification and those, the stringent of the two shall govern.</p> <p>Any special materials used, but not covered here, shall conform to relevant Indian</p>

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Clause No. PROPERTIES, STORAGES AND HANDLING OF COMMON BUILDING MATERIALS

Standards, if any, or as specified by the Engineer-in-Charge for any special purpose.

3.03.00 Some of the applicable Indian Standards, Codes are referred to here below:-

- | | | |
|-----------------------|---|---|
| IS:226 | : | Specification for structural steel (standard quality) |
| IS:269 | : | Specification for ordinary Portland cement, 33 grade. |
| IS:383 | : | Specification for coarse and fine aggregates from natural sources for concrete. |
| IS:432
(Parts 1&2) | : | Specification for mild steel and medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. |
| IS:455 | : | Specification for Portland slag cement. |
| IS:712 | : | Specification for building limes. |
| IS:1077 | : | Specification for common burnt clay building bricks. |
| IS:1127 | : | Recommendations for dimensions and workmanship of natural building stones for masonry work. |
| IS:1129 | : | Recommendation for dressing of natural building stones. |
| IS:1489 | : | Specification for Portland pozzolana cement: |
| Part (I) | : | Fly ash based. |
| Part (II) | : | Calcined clay based. |
| IS:1452 | : | Specification for sand for plaster. |
| IS:1566 | : | Specification for hard-drawn steel wire fabric for concrete reinforcement. |
| IS:1597
(Part 1) | : | Code of practice for construction of stone masonry, rubble stone masonry. |
| IS:1786 | : | Specification for high strength deformed bars for concrete reinforcement. |
| IS:2062 | : | Specification for structural steel (fusion welding quality). |
| IS:2116 | : | Specification for sand for masonry mortars. |

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Clause No. PROPERTIES, STORAGES AND HANDLING OF COMMON BUILDING MATERIALS

IS:2185 (Parts-I to VIII)	: Testing of aggregates for concrete.
IS:2691	: Burnt clay face bricks.
IS:3495 (Parts-I to IV)	: Methods of tests of burnt clay building bricks.
IS:4031	: Methods of physical tests for hydraulic cement.
IS:4032	: Methods of chemical analysis of hydraulic cement.
IS:4082	: Recommendations on stacking and storage of construction materials at site.
IS:7969	: Safety code for handling and storage of building materials.
IS:8112	: High strength ordinary Portland cement.
IS:8500	: Medium and high strength structural steel.
IS:12269	: 53 grade ordinary Portland cement.
IS:12330	: Sulphate resisting Portland cement.
IS:12600	: Portland cement, low heat.
IS:12894	: Fly Ash Lime Bricks – specification.

4.00.00 BRICKS

- 4.01.00 Burnt clay bricks, for general masonry work, shall conform to IS: 1077 and for face brick work, shall conform to IS: 2691. Fly ash lime bricks shall conform to IS: 12894.
- 4.02.00 Bricks for general masonry work shall be table moulded/machine made, well burnt without being vitrified, of uniform size, shape, having sharp edges and cherry red colour. These shall be free from cracks, flaws or nodules of free lime and shall emit clear ringing sound (metallic sound) when struck. These shall not show any signs of efflorescence either when dry or subsequent to soaking in water. Fractured surface shall show uniform texture free from grits, lumps, holes etc.
- 4.03.00 Unless otherwise specified, minimum compressive strength shall correspond to class designation 75 as per IS: 1077 with a minimum crushing strength of 75 kg/sq.cm. for general masonry work. However, for non-load bearing walls, bricks pavements, etc., bricks of class designation 50 shall only be used, wherever specified or shown on the

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drawings. Water absorption after 24 hours immersion shall not exceed 20% by weight for common bricks and 15% for face bricks.

4.04.00 On the basis of finish and dimensional tolerance, the bricks shall be classified as sub class A and B. Dimensional tolerance shall not exceed 3% and 8% of the size, of common bricks for sub-class A & B respectively and 3% for face bricks. All bricks shall have rectangular faces and sharp straight edges. Maximum permissible chippage for the face bricks shall be 6mm at the edges and 10mm for corners. The face bricks shall show no efflorescence after soaking in water and drying in the shade.

4.05.00 The size of the bricks used shall be either modular size as per IS: 1077 or locally available conventional size as approved by the Engineer-in-Charge.

4.06.00 Each brick shall have the manufacturer's identification mark clearly marked on the frog. The colour and texture of face bricks shall be limited to the range of samples submitted. Any brick not found upto the satisfaction of the Engineer-in-Charge shall be removed immediately from site by the contractor.

5.00.00 STONES

5.01.00 All stones shall be from approved quarries. These shall be hard, tough, durable, compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky or earthy appearance. Stone with round surface shall not be used.

5.02.00 Stones showing mottled colours shall not be used for face work. A stone shall not absorb more than 5% of its weight of water after 24 hours immersion. The type of stone shall be as specified or as shown on drawings and/or as instructed by the Engineer-in-Charge. Stones used for masonry work shall conform to IS: 1597 (Part-1). No soft stone shall be used for masonry or for filling purpose.

5.03.00 Any stone not found upto the satisfaction of Engineer-in-Charge shall be removed immediately from site by the Contractor.

6.00.00 LIME

6.01.00 Lime shall be stone lime and it shall confirm to IS: 712. Hydrated lime shall be mixed with water to form putty. This shall be stored with reasonable care to prevent evaporation of water for at least 24 hours before use. Quick lime shall be slaked with enough water to make a cream and then stored with reasonable care to prevent evaporation of water for at least seven days before use. Type of lime to be used for different purposes such as concreting, plastering, white washing etc. shall be according to the classification made here under :

Class – A : Eminently hydraulic lime used for structural purposes.

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- Class – B : Semi-hydraulic lime used for masonry mortars, lime concrete and plaster undercoat.
- Class – C : Fat lime used for finishing coat in plastering, whitewashing, composite mortars, etc. and with addition of pozzolanic materials for masonry mortar.
- Class – D : Magenisum/dolomitic lime used for finishing coat in plastering, whitewashing, etc.
- Class – E : Kankar lime used for masonry mortar.
- Class – F : Siliceous dolomitic lime used for undercoat and finishing cot of plaster.

7.00.00 CEMENT

- 7.01.00 i) Cement shall be ordinary Portland cement, 43 grade conforming to IS: 8112. The Engineer-in-Charge may permit the use of Portland pozzolana cement conforming to IS: 1489 or Portland slag cement conforming to IS: 455. However, OPC, PPC and PSC should never be mixed. High grade (strength) ordinary cement conforming to IS: 12269 shall be used only for producing very high grade of concrete.
- ii) All bulk carriers of cement shall be clean and dry prior of filling / loading with cement. All carriers for both bulk and bagged cement shall be equipped with weatherproof closures on all openings.
- iii) Arrangements shall be made such that stocks of approved cement are adequate to meet the program of work at all times. The program shall allow time for testing and approval of each shipment before such cement is incorporated in the works.
- iv) Cement shall be used in the order of lots in which it is received at site. Cement stored by the contractor and found unfit for use shall not be allowed to be used.
- v) The bidder shall price his bid on the basis of the following cement contents for various grades of concrete.

Grade of Cement per IS:456	28 th day characteristic strength (MPa) per IS:456	Preliminary avg. strength of 3 samples (MPa) per IS:516	Cement content (kg per m ³)
M – 15	15	20	270
M – 20	20	26	310
M – 25	25	32	400
M – 30	30	38	500

Note that the value “30” in M-30 represents a specified 28th day characteristic strength of 30 MPa for 15 cm cubes as per Indian Standards IS: 456. In order to guarantee this strength the average of 3 samples at 28 days shall have a preliminary minimum strength of 30 MPa as per IS: 516.

- vi) Since the strength of concrete is mainly dependent on the quality of the aggregate used, and this is still to be determined, the cement quantity is

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therefore indicative only and actual cement quantity shall be dependent on the Mix design.

- vii) If at any time, the Engineer-in-Charge considers that the cement being used by the Contractor is not upto the specification, he may suspend the work and send the samples of the cement to a testing laboratory for standard tests. The contractor shall also have no claim for such suspension of work. Changing of type of cement within the same structure shall not be permitted without the prior approval of the Engineer-in-Charge.

8.00.00 WATER

8.01.00 Water used for cement concrete, mortar, plaster, grouting, curing, washing of coarse aggregate, soaking of bricks, etc. shall be clean and free from injurious amount of oil, acids, alkalis, organic matters or other harmful substances in such amounts that may impair the strength or durability of the structure. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. The Contractor shall carry out necessary tests in advance to prove the suitability of the water proposed to be used. As a guide, the following concentrations represent the maximum permissible values :

- a) To neutralize 200ml samples of water, it should not require more than 2 ml of 0.1 normal NaOH.
- b) To neutralize 200ml samples of water, it should not require more than 10ml of 0.1 normal HCL.
- c) Percentage of solids shall not exceed the following :
 - (i) Organic0.02
 - (ii) Inorganic 0.30
 - (iii) Sulphates..... 0.05
 - (iv) Chlorides..... 0.10
 - (v) Suspended matter..... 0.20

9.00.00 AGGREGATES

9.01.00 General

- i) Unless otherwise specified concrete aggregates shall conform to the requirements of IS: 456 and IS: 383. They shall be tested in accordance with the provisions of IS: 2386.
- ii) Aggregates shall be supplied only from sources/quarries approved by the Engineer-in-Charge. Approval of a source shall not be construed as constituting acceptance of all materials to be taken from that source.
- iii) The quality of all aggregates used in the work, including processing such as washing, classifying, screening, re-screening, crushing and blending, necessary

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to meet the required specifications, shall all be subject to acceptance of the Engineer-in-Charge.

9.02.00 Fine Aggregates

- i) Sand or fine aggregates shall be used for mortar in stone masonry and as fine aggregates in concrete work.
- ii) It shall be either natural river sand or manufactured, sand crushed from rock/stones or mixture of both in specified proportions. The sand shall be hard, clean and gritty and of a quality approved by the Engineer-in-Charge. It shall be free from injurious amount of clay, soft and flaky particles, vegetable or organic matter, loam, mica and other deleterious substances and shall not contain any salts.
- iii) The fine aggregates shall conform to the requirements of IS: 383. Varying amount of moisture in fine aggregates contributes to lack of uniformity in concrete consistency. The fine aggregates shall therefore have uniform and stable moisture contents. Dry sand shall be preferred. Hence sand stockpiles shall be protected from rainfall.
- iv) The percentage of deleterious substances in the fine aggregates shall conform to relevant Standards except that the fine aggregate shall contain not more than 0.10 percent by weight of deleterious (reactive) ferrous sulphides. The total percentage of deleterious substances must not exceed 5 percent of the weight.

Deleterious substance	Maximum permissible Limit by weight
Materials finer than IS sieve No. 8	3%
Shale	1%
Coal and lignite	1%
Clay lumps	1%
Cinders and clinkers	0.50%
Alkali, mica and coated grain (deleterious)	2%

- v) Fine aggregates having a specific gravity of less than 2.50 are liable to be rejected. Fine aggregates when subjected to a soundness test with a solution of sodium sulphate, after 5 cycles of tests, shall not suffer a loss of weight in excess of 10%.
- vi) The sand shall be well graded and, when tested by standard sieves, shall conform to the prescribed limits of gradation. The best gradation shall be determined by the Engineer-in-Charge, after experiments and tests and the Contractor shall follow the same.
- vii) The sand, as delivered to the batching plant shall have a fineness modulus of 2.6 to 3.
- viii) The grading of fine aggregates shall be so controlled that the fineness moduli of at least 9 out of 10 samples of the fine aggregates delivered to the batching

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plant shall not vary more than 0.20 from the average of 10 samples tested. All classifying, batching or other operations on the fine aggregates shall be done by the Contractor.

- ix) For improving workability of pumped concrete mixes, the Contractor may consider a combination of natural and manufactured sand. Proposed proportions shall be submitted for approval of the Engineer-in-Charge.
- x) Maximum amount of material finer than 75 micron shall not exceed 1% by weight.
- xi) The gradations shown in the following chart are indicative only (As per IS: 515-1959).

Sieve size IS	Percentage Passing	
	Natural Sand	Manufactured Sand
480 (4.75 mm)	95 to 100	95 to 100
240 (2.36 mm)	80 to 95	75 to 90
120 (1.18 mm)	45 to 80	50 to 70
60 (600 micron)	30 to 45	30 to 50
30 (300 micron)	5 to 30	15 to 30
15 (150 micron)	1 to 5	8 to 13
8 (75 micron)	0 to 1	0 to 1

9.03.00 Coarse Aggregates

- i) Coarse aggregate shall consist of screened natural gravel or crushed rock and shall conform to the requirements of IS: 383.
- ii) The term coarse aggregate is used to designate aggregate that is reasonably well graded and ranging in size of particles from 4.75 mm to 150mm or any size or range of sizes within such limits. The coarse aggregate shall conform to relevant specifications of IS: 515 (for natural and all manufactured aggregate), or IS: 383-1970 (for natural aggregate as revised from time to time).
- iii) Coarse aggregate shall have a loss not more than 30% as determined by Los Angeles Abrasion test as specified in IS: 2386 Part IV.
- iv) When subject to the sodium sulphate soundness test, coarse aggregate shall not suffer more than 10 percent loss of weight after five cycles.
- v) Natural coarse aggregates shall consist of uncoated hard, strong, dense and durable pieces and shall be free from injurious amounts of disintegrated stones, soft flaky or elongated particles, salt, alkali, vegetable matter and other deleterious substances.
- vi) Coarse aggregate shall be hard, dense, durable, uncoated rock fragments. Rock having an absorption greater than 3% or specific gravity less than 2.5 shall not be used. Aggregate delivered to the batching plant shall have an uniform

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and stable moisture content.

- vii) Manufactured coarse aggregates shall consist of “very large”, “large”, “medium”, and “small” aggregates and shall be of uncoated hard, strong dense and durable pieces and shall be free from injurious amounts of soft or flaky particles salt, alkali, and vegetable matter and other deleterious substances (IS: 515).
- viii) Permissible deleterious substances in manufactured coarse aggregates shall not exceed the following limits:

Deleterious substance	Maximum permissible Limit (by weight)
Materials finer than IS sieve no. 8	1%
Coal and lignite	1%
Clay lumps	1%
Total soft, friable elongated or laminated pieces	3%
Other deleterious materials	As per note given below

- ix) Permissible deleterious substances in natural coarse aggregate: Total of all deleterious substances shall not exceed 5% by weight and the coarse aggregate shall not contain more than 0.3% by weight of deleterious (reactive) ferrous sulphide.
- x) The aggregate shall be resistant to chemical or physical change such as cracking, swelling, softening, leaching, or other chemical alteration after its incorporation in concrete.
- xi) The aggregate should be crushed and the different sizes of the coarse aggregate shall be separated into nominal sizes as follows:

Designation	Nominal size range
Small	5 mm to 20 mm
Medium	20 mm to 40 mm
Large	40 mm to 75 mm
Very Large	75 mm to 150 mm

- xii) Coarse aggregate shall be washed at the aggregate source, however, further washing at the batching plant may be required if the aggregate is found to be unacceptable to the Engineer-in-Charge.
- xiii) As far as possible, coarse aggregates shall be of regular shape and free of flat or elongated particles. The volumetric coefficient C, which defines the ratio of the total volume of number of particles at random and the volume of spheres having a diameter equal to the greatest dimension of each element, shall be greater than or equal to the following values:

Aggregate Size	Ratio
6.7 / 26.5 mm	C = 0.15
26.5 / 150.0 mm	C = 0.11

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Clause No.	PROPERTIES, STORAGES AND HANDLING OF COMMON BUILDING MATERIALS
10.00.00	REINFORCEMENT STEEL, STRUCTURAL STEEL (INCLUDING EMBEDDED STEEL) AND WIRE MESH
10.01.00	All steel for reinforcement shall be clean and free from loose mill scales, dust, loose rust, oil grease, paint or other harmful matters which may affect its bond with concrete. Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement shall conform to grade-1 of IS: 432 (Part-1). High strength deformed steel bars shall conform to grade Fe 415 of IS: 1786. All steel bars shall be of tested quality. Actual grade and type of steel, to be used, shall be as specified or shown on drawings.
10.02.00	Structural steel (including embedded steel) shall be straight, sound, free from twists, cracks, flaws, laminations and all other defects. Structural steel shall be of tested quality conforming to IS: 226, IS: 2062 or IS: 8500. These shall be free from lamination defects. Grade and type of steel to be used shall be as specified.
10.03.00	Hard drawn steel wire fabric shall conform to IS: 1566. Wire fabric shall be electrically cross welded.
11.00.00	STORAGE AND HANDLING OF MATERIALS
11.01.00	Generally, all materials shall be stacked and stored by the Contractor as described in IS: 4082 unless otherwise mentioned and in a manner affording convenient access for identification and inspection at all times. The storage area and arrangement shall be subject to the approval of the Engineer-in-Charge. Any material rendered unserviceable during the Contractor's custody, shall be replaced or repaired by the Contractor as determined by the Engineer-in-Charge.
11.02.00	All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material which was deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-Charge, shall not be used and shall be removed and the cost thereof, shall be realised from the Contractor's dues. The Contractor shall maintain upto date accounts of receipts, issue and balance (stock-wise) of all materials.
11.03.00	Bricks shall not be dumped at site. These shall be stacked on dry firm ground in regular tiers even as they are unloaded to minimise breakage and defacement of bricks. Bricks of different class, selected for various categories of use in the work, shall be stacked separately. Each stack shall contain equal number of bricks, preferably not more than 3000.
11.04.00	Dressed stone for all facing, paving etc. shall be stored with special care to avoid defacement of faces and edges or damp sand rust stains.
11.05.00	Lime shall be stored in weather-proof sheds. Lime which has been damaged by rain, moisture or air slaking shall not be used. If the lime is supplied as hydrated lime, it shall

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be stored in the same manner as cement.

11.06.00 Cement

- a) Consignments of cement shall be stored as received and shall be consumed in the order of their delivery. Cement held in storage for more than ninety days shall invariably be tested, and only if test results are satisfactory, the Engineer-in-Charge may consider permitting its use.
- b) Different consignments of different types of cement i.e. OPC, PPC, PSC shall be stacked separately with clear identifiable stack number.
- c) The cement shall be stored in dry, leak proof and weather proof enclosed sheds. Storage under tarpaulins shall not be permitted. The cement bags shall be stored well at least 30cm away from the walls and insulated from the floor by at least 15 to 30 cm, using wooden planks etc., to avoid contact with moisture. The cement shall be stacked in easily countable stacks not more than 10 bags (4.5m) to prevent bursting of bottom bags and in a place of easy access so as to facilitate proper inspection and removal on a first in first out basis. However, in stacks more than 8 bags high, the cement bags shall be arranged alternatively lengthwise and crosswise so as to tie the stacks together and minimise the danger of toppling over. The cement bags shall be gently kept to avoid leakage of cement from the bags. Substandard or partially set cement shall be immediately removed from the site as soon as it is detected.
- d) The Contractor shall make his own arrangements for the storage of adequate quantity of cement. Cement in bulk may be stored in bins or silos which will provide adequate protection against dampness, contamination, etc. The bins or silos shall be cleaned periodically.

11.07.00 Coarse and Fine Aggregates / Sand

- a) Coarse and fine aggregates shall be stacked separately. Contamination with foreign materials and earth during storage and while heaping the materials shall be avoided. Coarse aggregates shall be stacked in layers not exceeding 120 cm in height such that coning and segregation do not occur. Each layer shall cover the entire area of the stock pile before succeeding layers are placed. Segregated aggregates from stockpile shall be rejected.
- b) Aggregate shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other injurious substance, at any stage. For lifting aggregates from stock piles, rakers shall be used. Aggregates of different sizes shall be kept in separate and easily measurable stacks. If so desired by the Engineer-in-Charge, aggregates from different source shall be stacked separately with proper care to prevent intermixing.

11.08.00 Reinforcement and Structural steel (including Steel required for embedment)

- a) Reinforcement and structural steel (including steel required for embedment) shall be stored consignment wise and size wise, off the ground by at least 150mm and protected by the suitable cover, or as desired by the Engineer-in-Charge. The steel shall be protected from rusting, oil, grease and distortions.

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Clause No. PROPERTIES, STORAGES AND HANDLING OF COMMON BUILDING MATERIALS

The reinforcing steel shall be coated with cement wash before stacking to prevent scale and rust, in areas having accelerating corrosion effect like marine atmosphere. The stacks shall be easily measurable. Steel needed for immediate use only shall be removed from storage. Fabricated steel shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

- b) Reinforcement shall be stored according to the diameter, grade and length in such a place as to permit easy approach for inspection and identification.
- c) The area shall be such that water does not accumulate and reinforcement does not get distorted or corroded. It shall not be stacked directly over ground or near any harmful materials. It shall be cleaned of excessive rust before use.
- d) Steel plates of different specifications shall be stacked separately. Steel of IS: 2062 and IS: 8500 quality shall be given a grade-wise, distinctive identification mark. Passage and space between the stacks shall be sufficient before rigging operations.

12.00.00 TESTING

- 12.01.00 All materials provided by the Contractor shall be tested for conformity of the specification and the test results shall be submitted to the Engineer-in-Charge for acceptance. In addition to above, the Contractor shall carryout the relevant tests at site as specified under different items of work.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS																						
SECTION – 01																							
1.00.00	COMMON REQUIREMENTS																						
1.01.00	SCOPE																						
1.01.01	The work shall include providing of materials, all necessary plant and equipment, providing adequate engineering supervision and technical personnel, skilled and unskilled labour, etc. as required to carry out the entire work as indicated on the drawings and/or described herein subsequently and/or as directed by the Engineer-in-Charge.																						
1.01.02	The Contractor shall carry out all works meant within the intent of this specification even if not explicitly mentioned herein. All works shall be executed to the satisfaction of the Engineer-in-Charge.																						
1.01.03	<p>This specification is divided into 11 sections. The Section-1 deals with common requirements and the other 10 sections deal with specifications for 10 different items/activities. The stipulations contained in Section-1, 'Common Requirements' shall form a part of the specifications of 10 different items/activities described in sections 2 to 11.</p> <p>All these eleven sections are as follows :</p> <table> <tr> <td>Section – 01</td><td>: Common requirements</td></tr> <tr> <td>Section – 02</td><td>: Cast-in-Situ Concrete</td></tr> <tr> <td>Section – 03</td><td>: Reinforcement</td></tr> <tr> <td>Section – 04</td><td>: Formwork and staging</td></tr> <tr> <td>Section – 05</td><td>: Embedded parts</td></tr> <tr> <td>Section – 06</td><td>: Foundation bolt assembly</td></tr> <tr> <td>Section – 07</td><td>: Joints in Concrete</td></tr> <tr> <td>Section – 08</td><td>: Water proofing of Water Bearing and Underground concrete structures.</td></tr> <tr> <td>Section – 09</td><td>: Cement Additives/Admixtures in concrete.</td></tr> <tr> <td>Section – 10</td><td>: Grouting & Underpinning</td></tr> <tr> <td>Section - 11</td><td>: Encasement of Steel structures/elements.</td></tr> </table>	Section – 01	: Common requirements	Section – 02	: Cast-in-Situ Concrete	Section – 03	: Reinforcement	Section – 04	: Formwork and staging	Section – 05	: Embedded parts	Section – 06	: Foundation bolt assembly	Section – 07	: Joints in Concrete	Section – 08	: Water proofing of Water Bearing and Underground concrete structures.	Section – 09	: Cement Additives/Admixtures in concrete.	Section – 10	: Grouting & Underpinning	Section - 11	: Encasement of Steel structures/elements.
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Section - 11	: Encasement of Steel structures/elements.																						
1.02.00	GENERAL																						
1.02.01	Any approval, instructions, permission, checking, review, etc. whatsoever by the Engineer-in-Charge, shall not relieve the Contractor of his responsibility and obligation																						

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
	regarding adequacy, correctness, completeness, safety, strength, quality, workmanship etc.
1.02.02	The contractor shall make his own surveying arrangements for locating the coordinates and positions of all work and establishing the reduced levels (RLs) at these locations, based on two reference grid lines and one bench mark, which will be furnished by the Owner. The Contractor has to provide at site, all the required survey instruments, alongwith qualified surveyors, to the satisfaction of the Engineer-in-Charge so that the work can be carried out accurately and according to the specifications and drawings.
1.03.00	CODES AND STANDARDS
1.03.01	All applicable standards, specifications, etc. and codes of practice shall generally be the latest editions, including all applicable official amendments and revisions. A complete set of all these documents shall generally be available at site, with the Contractor.
1.03.02	All work shall be carried out as per the stipulations contained in various sections of these specifications and the latest Indian Standards, Acts, Codes and best practices.
1.03.03	In case of conflict between the stipulations contained in various sections of these specifications and stipulations of Indian Standards Codes etc., the stringent of the two shall govern.
1.03.04	Some of the applicable Indian Standards, Codes, etc. are referred to here below :- <ul style="list-style-type: none"> IS:226 : Specification for structural steel (standard quality) IS:269 : Specification for Ordinary Portland cement, 33 grade. IS:280 : Specification for mild steel wire for general engineering purposes. IS:383 : Specification for coarse and fine aggregates from natural sources for concrete. IS:432 (Parts I & II) : Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement. IS:455 : Specification for Portland slag cement. IS:456 : Code of practice for plain and reinforced concrete. IS:457 : Code of practice for general construction of plain and reinforced concrete for dams and other massive structures. IS:516 : Method of test for strength of concrete.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
IS:650	: Specification for standard sand for testing of cement.
IS:702	: Specification for industrial bitumen.
IS:816	: Code of practice for use of metal arc welding for general construction in mild steel.
IS:1199	: Methods of sampling and analysis of concrete.
IS:1200 (Part-II, V, VIII, XVIII)	: Method of measurement of building and civil engineering works.
IS:1322	: Specification for bitumen felts for waterproofing and damp proofing.
IS:1363	: Black Hexagon Bolts, Nuts and Lock Nuts and Black Hexagon screws
IS:1367	: Technical supply conditions for threaded steel fasteners.
IS:1489	: Specification for Portland-pozzolana cement.
IS:1566	: Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS:1609	: Code of practice for laying damp proof treatment using bitumen felts.
IS:1786	: Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:1791	: General requirements for batch type concrete mixers.
IS:1838 (Part-I)	: Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type)
IS:2016	: Plain washers
IS:2074	: Ready Mixed Paint, Red Oxide Zinc Chromate Primer
IS:2386 (Parts-I to VIII)	: Methods of test of aggregates for concrete.
IS:2438	: Specification for roller pan mixer.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
IS:2502	: Code of practice for bending and fixing of bars for concrete reinforcement.
IS:2505	: General requirements for concrete vibrators, immersion type.
IS:2506	: General requirements for concrete vibrators, screed board type.
IS:2514	: Specification for concrete vibrating tables.
IS:2645	: Specification for Integral cement water proofing compounds.
IS:2722	: Specification for portable swing weigh batchers for concrete. (single and double bucket type)
IS:2750	: Specification for steel scaffoldings.
IS:2751	: Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS:3067	: Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3150	: Specification for hexagonal wire netting for general purposes.
IS:3366	: Specification for Pan vibrators.
IS:3370 (Part I to IV)	: Code of practice for concrete structures for the storage of liquids.
IS:3384	: Specification for bitumen primer for use in waterproofing and damp proofing.
IS:3414	: Code of practice for design and installation of joints in buildings.
IS:3550	: Methods of test for routine control for water used in industry.
IS:3558	: Code of practice for use of immersion vibrators for consolidating concrete.
IS:3696 (Part I & II)	: Safety code for scaffolds and ladders.
IS:4014 (Parts I & II)	: Code of practice for steel tubular scaffolding.
IS:4031	: Methods for physical tests for hydraulic cement.
IS:4130	: Safety Code for demolition of buildings.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
IS:4326	: Code of practice for earthquake resistant design and construction of buildings.
IS:4656	: Specification for form vibrators for concrete.
IS:4925	: Specification for batching and mixing plant.
IS:4990	: Specification for plywood for concrete shuttering work.
IS:5121	: Safety code for piling and other deep foundations.
IS:5256	: Code or practice for sealing joints in concrete lining on canals.
IS:5525	: Recommendations for detailing of reinforcement in reinforced concrete work.
IS:5624	: Specification for foundation bolts.
IS:6461	: Glossary of terms relating to cement concrete.
IS:6494	: Code of practice for water proofing of underground water reservoirs and swimming pools.
IS:6509	: Code of practice for installation of joints in concrete pavements.
IS:7193	: Specification for glass fibre base coal-tar pitch and bitumen felts.
IS:7293	: Safety code for working with construction machinery.
IS:7861 (Parts I & II)	: Code of practice for extreme weather concreting.
IS:9012	: Recommended practice for shotcreting.
IS:9103	: Specification for admixtures for concrete.
IS:9417	: Recommendations for welding cold-worked steel bars for reinforced concrete construction.
IS:9595	: Recommendations for metal-arc welding of carbon and carbon manganese steels.
IS:10262	: Recommended guidelines for concrete mix design.
IS:11384	: Code of practice for composite construction in structural steel and concrete.
IS:12118	: Specification for two-part poly sulphide.

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IS:12269	: 53 Grade ordinary Portland cement.
IS:12600	: Portland cement, low heat.
SP:23	: Handbook of concrete mixes.
SP:34	: Handbook on concrete reinforcement and detailing.
1.04.00	SAMPLING, TESTING AND QUALITY ASSURANCE
1.04.01	Facilities required for sampling materials, concrete, reinforcement, formwork, etc. in the field and in the laboratory shall be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the International Standards or the prevalent accepted engineering practice to the directions of the Engineer-in-Charge. Tests shall be done in the field in the presence of the Engineer-in-Charge or his authorised representative and at a laboratory, approved by the Engineer-in-Charge, and the Contractor shall submit to the Engineer-in-Charge the test results in triplicate within three days after completion of any test.
1.04.02	The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer-in-Charge. The Engineer-in-Charge at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.
1.04.03	Work found unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per specification requirements and to the satisfaction of the Engineer-in-Charge at no extra cost to the Owner.
1.04.04	<p>Quality Assurance Programme</p> <p>a) The Contractor shall submit and finalised a detailed field Quality Assurance Programme within 30 days from the date of award of the contract, before commencement of work at site, according to the requirements of the specification. That shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, field quality plan, etc. On finalised field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer-in-Charge. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the authorised persons as frequently as possible to give accurate testing results.</p> <p>b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in respective sections. However, the testing frequencies set forth are the desirable minimum and the Engineer-in-Charge shall have the full authority to carryout or call for tests as frequently as he may deem necessary to satisfy himself that the</p>

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	materials and works comply with the appropriate specifications.

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SECTION – 02	
2.00.00	CAST-IN-SITU CONCRETE
2.01.00	SCOPE
2.01.01	This section of the specification deals with plain or reinforced cement concrete for general use and in structures and covers the requirements for concrete, materials, their properties, storage, handling, grading, mix design, strength and quality, pouring at all levels, testing, casting, protecting, curing, finishing, etc.
2.02.00	GENERAL REQUIREMENTS
2.02.01	The provision of IS: 456 shall be followed as general guidance, alongwith all other relevant Indian Standards, unless otherwise specifically mentioned.
2.02.02	Before starting a concrete pour, the Contractor shall obtain the approval of the Engineer-in-Charge on a 'Pour Card' maintained for this purpose. He shall obtain complete instructions about the materials and proportions, water cement ratio, etc. to be used, slump/workability, number of test cubes/samples to be taken, type of finishing to be done, any admixture to be added, any limitation on size of pour and location for interruption of a pour in case of premature stopping of pour, etc.
2.02.03	The mixers and weigh-batchers shall be maintained in clean and serviceable condition. Accuracy of all equipment shall be periodically checked. All concrete shall be mixed in mechanically operated batch mixers complying with IS: 1791 and these shall be of approved make, with suitable provision for correctly controlling the water delivered to the drum. Weigh batchers shall conform to IS: 2722 and shall be capable of controlling the weights to within one percent of the desired value.
2.02.04	The Contractor's procedures for casting massive concrete sections (as noted on the drawings or as identified by the Engineer-in-Charge) shall take account of the release of the heat of hydration, drying shrinkage behaviour. The procedures shall be such that cracking or loss of strength of the concrete from these effects is prevented. At least one week before commencing the construction of any massive concrete section, the Contractor shall submit, for approval of the Engineer-in-Charge, detailed proposals for placing the concrete together with supporting calculations to demonstrate the methods.
2.03.00	MATERIALS
2.03.01	In general, all the materials used in the manufacture of concrete shall be in accordance with the Technical Specification for Properties, Storage and Handling of Common Building Materials, as per IS:4082.
2.03.02	The Engineer-in-Charge shall have the right to inspect the source of materials, method

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	of procurement and storage of materials, quality control procedures, etc.
2.03.03	<p>Cement</p> <p>The cement used shall be the Ordinary Portland cement conforming to IS: 8112 or Portland Pozzolana cement conforming to IS: 1489 or Portland slag cement conforming to IS: 455 or any other type of cement specified in IS: 456 with the prior approval of the Engineer-in-Charge. However, any special type of cement such as High strength cement or sulphate resisting cement may be used under special circumstances.</p>
2.03.04	<p>Aggregates</p> <p>a) For reinforced concrete work, aggregates conforming to IS: 383 & 2386 having a maximum size of 20mm shall be used. However, for certain reinforced concrete works, aggregates having a maximum size other than 20mm size shall also be used.</p> <p>b) Aggregates (coarse or fine) with a specific gravity below 2.5 shall not be used without special permission of the Engineer-in-Charge. Machine-made sand will be acceptable provided the constituent (rock/gravel) is sound, hard, dense and is acceptable to the Engineer-in-Charge. Sand, natural gravel and crushed rock shall be prepared for use by such screening or washing, or both, as necessary to removal all objectionable foreign matter.</p> <p>c) Type of aggregates: - Petrographic examination shall be carried out to ascertain the structure and rock type of aggregate including presence of strained quartz and other reactive minerals. Moreover, in case the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining different rock type is in the composite sample, special emphasis should be given on chalcedony, opal etc. and procedure laid down in IS: 2430 for sampling of aggregates may be followed. The sample should not contain weathered rock and reduced to required quantity by quartering and coning.</p> <p>The results of petrographic test shall be submitted to the Engineer-in-Charge. The Engineer-in-Charge shall review the results on consultation with some specialist agencies, if required, to determine potential reactivity of the aggregate (siliceous minerals) which may lead to reaction of silica in aggregate with the alkalis of cement. In addition, potential of some aggregate like lime stone to residual expansion due to repeated temperature cycle is also to be reviewed. Further, the Contractor shall submit the results of Alkali aggregates reactivity carried out as per IS: 2386 (Pt.VII).</p> <p>In case of any apprehension about the properties of the aggregate, the Engineer-in-Charge shall ask the contractor to send samples of coarse and fine aggregate to any of the established research laboratory including National Council for Cement and Building Materials, (NCB), Ballabgarh for further testing. However, the Owner shall fix the agency and bear the cost of testing.</p> <p>In case, it is established from the tests that the aggregates contain reactive</p>

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	<p>silica which would react with alkalis of the cement, the Contractor shall be asked to change the source of supply of the aggregate and take additional measures as suggested. In case aggregates indicate residual expansion, under repeated temperature cycle test, the material shall not be used for concreting of T.G., BFP, Fans and other equipment foundations which are likely to be subjected under repeated temperature cycle. The Contractor shall use different type of aggregate as approved by the Engineer-in-Charge.</p>
2.03.05	<p>Admixtures</p> <ul style="list-style-type: none">i) The Contractor shall furnish suitable plasticizers and chemical admixtures for use in concrete as provided herein. The admixtures shall be of uniform consistency and quality, and shall be maintained at the job site at uniform strength of solution. Admixtures shall be batched separately in liquid form in dispensers capable of measuring at one time the full quantity of each admixture required for each batch. Admixtures dispensers shall be constructed and located such that the plant operator can observe the full batch quantity of each admixture in a visual gauge. Each admixture shall be discharged into the batched mixing water so that water is being discharged into the mixer as the admixture is added.ii) Admixture will be accepted on manufacturer's certifications. However, the Engineer-in-Charge reserves the right to require submission of and to perform tests on samples of any admixture either prior to shipment to the job site or after delivery.iii) When requested by the Engineer-in-Charge the Contractor shall submit test data by the manufacturer conforming total compliance of the admixture to these specifications.iv) The contractor shall be responsible for any difficulties arising as a result of the selection and use of admixtures, such as difficulty in concrete placing and delay in concrete finishing and form removal. The Contractor shall be entitled to no additional compensation by reason of such difficulties. Chemical admixtures containing calcium chloride shall not be used in concrete.v) Accelerating admixtures, wherever required, shall be used after prior approval of the Engineer-in-Charge.vi) Water reducing, set controlling:<ul style="list-style-type: none">a) The contractor shall use a water reducing, set controlling admixtures in all concrete. The admixture shall conform to IS specification or equivalent standard.b) The amount of water reducing Admixtures used shall be that amount necessary to effect the requirements of Indian Standard specifications or equivalent and as directed by the Engineer-in-Charge. The Engineer-in-Charge reserves the right to adjust the quantities of water reducing admixtures or eliminate its use and the contractor shall be entitled to no additional compensation for such adjustments.

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2.04.00	WATER
2.04.01	Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete.
2.04.02	In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time tests specified in IS: 456.
2.04.03	Average 28 days compressive strength of at least three 150mm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with IS: 456.
2.04.04	The initial setting time of a concrete test block made with the appropriate cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by +30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. The test shall be carried out as per IS: 516.
2.04.05	Where concrete, made from water, proposed to be used does not satisfy the above requirements and/or contains an excess of acid, alkali sugar, salt or other deleterious substances, then the Engineer-in-Charge may refuse to permit its use.
2.05.00	GRADES OF CONCRETE
	All concrete shall be "design mix concrete" as defined in IS: 456, unless a nominal mix concrete such as 1:2:4 or 1:3:6 proportion is specified. The proportion referred to is by mass. The grades for 'design mix' concrete shall be designated M-20, M-25, etc. as specified in IS: 456.
2.05.01	Nominal mix Concrete
	<p>a) Nominal mix concrete shall be used only for plain Cement concrete works and where shown on drawings or specifically allowed by the Engineer-in-Charge. Such concrete shall not require preparation of trial mixes and all such concrete shall be mixed in a mechanical mixer. Proportions for nominal mix concrete shall be done according to the provisions kept in Table-3 of IS: 456.</p> <p>b) In proportioning concrete, the cement shall be measured by weight. The quantities of fine and coarse aggregates may be determined by volume (for corresponding weight) but preferably by weight. If fine aggregate are moist, the amount of surface water shall be determined and allowance shall be made for bulking in case of volume batching, in accordance with IS: 2386 (Part-III). Allowance shall also be made for surface water present in the aggregates, when computing the water requirement. All the above data shall be maintained properly, to the satisfaction of the Engineer-in-Charge.</p>

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- c) The recommended maximum water cement ratios are specified in Table-1.

TABLE – 1

RECOMMENDED WATER-CEMENT RATIO

Nominal mix concrete	Quantity of water per 50kg. of cement (max)
1:3:6	34 litres
1:2:4	32 litres

2.05.02 Design Mix Concrete

- a) Design mix concrete shall be used on all concrete works, except where specified otherwise or specially permitted by the Engineer-in-Charge. The mix shall be designed for all grades of concrete (except those specified under Nominal Mix Concrete) such as to obtain for works cubes, the required workability and the characteristic strength not less than the appropriate values given in Table 2. Using Standard Deviation specified in IS: 10262, the Minimum value of target strength of design mix of various grades of concrete shall be as per Table 2.

TABLE -2

GRADES OF CONCRETE

Grade Designation of Concrete	Compressive strength of a 15 cm cube at 28 days (N/sq.mm)	
	Preliminary test strength (target strength of trial mix)	Characteristic strength on works cubes
M 15	19	15
M 20	26	20
M 25	32	25
M 30	38	30
M 35	44	35

- b) In proportioning concrete, the quantity of both cement and aggregates shall be determined by weight. However, only in some exceptional cases including concerting in some isolated areas, the Engineer-in-Charge may allow the quantity of aggregates to be determined by an equivalent volume basis after the relationship between weight and volume is well established by trials and the same shall be verified frequently. Water shall be either measured by volume in

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	<p>calibrated tank or weighted. All measuring equipment at site shall be maintained in a clean and serviceable condition, and their accuracy shall be periodically checked.</p> <p>c) To keep the water-cement ratio to the designed value, allowance shall be made for the moisture contents in both fine and coarse aggregates and determination of the same in accordance with IS: 2386 Part (III) shall be made as frequently as directed by the Engineer-in-Charge.</p> <p>In some of the structure, water-cement ratio shall be restricted even below 0.45. To increase the workability, plasticizer may have to be used in such cases. Trial mix shall be carried out accordingly.</p> <p>With the permission of the Engineer-in-Charge, for any of the above mentioned grades of concrete, if the water quantity has to be increased, proportionately cement quantity shall also be increased, to keep the ratio of water to cement same as adopted in Preliminary tests for the corresponding grade of concrete. The extra cement required on account of this shall also be considered for reconciliation purposes.</p>
2.05.03	<p>Mix Design</p> <p>a) IS: 10262 shall be followed as general guidance for mix design. Preliminary tests/trial mix, as specified or as required by the Engineer-in-Charge, shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of aggregates and cement expected to be used on the works. These tests are to be conducted to arrive at the grading of aggregates, water-cement ratio, workability and the quantity of cement required to give Preliminary (target) compressive strengths as specified in Table-2.</p> <p>b) Minimum cement contents, from durability consideration, or different exposures and sulphate attack shall be given in Table-19 and 20 of IS: 456. In case, higher value is obtained, from trial mix from strength consideration, same shall be provided.</p> <p>c) At least three trial mixes are to be made and minimum. Six test cubes taken for each trial mix noting the slump for each type of mix. The cubes shall then be properly cured and three cubes for each mix shall be tested in a laboratory (approved by the Engineer-in-Charge) at 7 days and others at 28 days for obtaining the compressive strength. The test reports shall be submitted to the Engineer-in-Charge. The design mix particulars shall indicate, with the help of graphs and curves etc. the extent of variation in the grading of aggregates which can be allowed. While designing mixes, over wet mixes shall be avoided.</p> <p>d) The Contractor shall submit the test reports of mix design to the Engineer-in-Charge for his views, indicating design criteria, analysis and proportioning of materials, etc. On the basis of the above test reports, a mix proportion by mass and the water-cement ratio, shall be determined by the Contractor such that concrete prepared with this mix will yield the desired characteristic strength and shall have suitable workability. The mix design to be adopted on the works shall be subject to the approval of the Engineer-in-Charge. The proportions, once decided for different grades of concrete, shall be adhered to, during all</p>

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concerting operations as long as the quality of the materials does not change. If, however, at any time, the quality of materials being used has changed from those for Preliminary mix design, or there is a concrete, or water-cement ratio or workability, the Contractor shall have to make similar trial mixes and Preliminary tests to ascertain the revised mix proportions and water-cement ratio to be used for obtaining the desired strength and consistency.

- e) In the situations, like casting of piles, where the compaction of concrete is not possible by vibration, the method of compacting concrete cubes of preliminary/trial mixes and work tests shall be in the same manner as the method of compacting concrete at site is proposed.

2.05.04 Workability of Concrete

- a) The workability of concrete shall be checked at frequent intervals. The workability of concrete measured in accordance with IS: 1199 for every sample taken for testing shall be recorded with the corresponding cube test result.
- b) The degree of workability necessary to allow the concrete to be well compacted and to be worked into the corners of formwork and round the reinforcement to give the required surface finish shall depend on the type and nature of the structure and shall be based on experience and tests. The suggested ranges of values of workability for concrete for some placing conditions, measured in accordance with IS: 1199 as stipulated under clause No. 6.0 of IS: 456, are given below in Table-3, for guidance only.

TABLE – 3

LIMITS OF WORKABILITY

Placing	Degree of Workability	Value of Workability
Concreting of shallow sections with vibration	Very low	20-10 seconds, Vee-bee time or 0.75-0.80 compacting factor.
Concreting of lightly reinforced section with vibration	Low	10-5 seconds, Vee-bee time or 0.80-0.85 compacting factor
Concreting of lightly reinforced section without vibration, or heavily reinforced sections with vibration.	Medium	5-2 seconds, Vee-bee time or 0.85-0.92 compacting factor or 25-75mm, slump for 20mm aggregate (for smaller aggregate the values will be lower).
Concreting of heavily reinforced sections without vibration.	High	Above 0.92 compacting factor or 75-125 mm slump for 20mm aggregate (for smaller aggregate the values will be lower).

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	<p>Note : Notwithstanding the values given above, the slump to be maintained for work in progress shall be as per directions of the Engineer-in-Charge.</p>
2.05.05	<p>Mixing of Concrete</p> <ul style="list-style-type: none"> a) Concrete shall be mixed in a mechanical mixer conforming to IS: 1791. However, mixing shall preferably be done at a single central batching plant, conforming to IS: 4925, situated within the area allocated for the Contractor's particular use as shown on the drawing or as directed by the Engineer-in-Charge. The plant shall have a mechanically operated mixer of an approved size and type, capable of ensuring a uniform distribution of the materials throughout the mass and the mass is uniform in colour and consistency. b) Water shall not be added into the drum of the mixer, until all the cement and aggregates constituting the batch are already in the drum and dry mixed for atleast one minute and are uniformly distributed. Water shall then be added and mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass but in no case shall mixing be done for less than two minutes and for atleast 40 revolutions after all the water and materials are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as directed by the Engineer-in-Charge. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing. c) The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used and it shall be immediately removed from site. Each time if the work stops for more than 30 minutes, the mixer shall be thoroughly cleaned and when the next mixing commences, the first batch shall have 10% additional cement which shall be considered for reconciliation. No extra cash shall be payable to contractor for this purpose. d) In exceptional circumstances and/or work in remote areas, hand mixing may be allowed by the Engineer-in-Charge, subject to adding 10% extra cement which shall be considered for reconciliation purposes. No extra cost shall be payable to contractor on the account.
2.05.06	<p>Concrete Conveying</p> <ul style="list-style-type: none"> a) Concrete shall be handled and conveyed as rapidly as practicable, from the place of mixing to the place of final laying, by approved means for ex. Tower Crane, Transit mixer, etc., before the initial setting of the cement starts. Concrete shall be conveyed in such a way that there is no segregation or loss of any of the ingredients and maintaining the required workability. If segregation does occur during transport, the concrete shall be remixed. During very hot or cold weather, if directed by the Engineer-in-Charge, concrete shall be transported in deep containers which will reduce the rate of water loss by evaporation in hot weather and heat loss in cold weather, at no extra cost to the Owner. b) Conveying equipment for concrete shall be mortar tight, well maintained and

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	<p>thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete. Chutes shall not be used for transport of concrete without the written permission of the Engineer-in-Charge. The chute in case permitted to be used shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flow without the use of an excessive quantity of water and without segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit.</p> <p>c) Concrete may be conveyed and places by mechanically operated equipment, e.g. pumps or pneumatic placers only with the written permission of the Engineer-in-Charge, who shall also review the entire scheme for which comprehensive details shall be furnished by the Contractor.</p>
2.05.07	<p>Concrete Placing</p> <p>a) Concrete shall be placed and compacted in its final position before the cement reaches the initial set and normally concrete shall be compacted in its final position within minutes of leaving the mixer.</p> <p>b) Where direct placement is not possible, the Contractor shall provide suitable arrangements such as chutes, tremie, elephant trunks, etc. to confine the movement of concrete as directed by the Engineer-in-Charge. Concrete shall not be dropped from a height or handled in a manner which may cause segregation.</p> <p>c) If concrete is placed by pumping, the consistency shall be the minimum necessary for such conveyance of concrete. Before commencement of regular pumping, the pipeline shall be lubricated by cement mortar (1:2), and once pumping commences, stoppages shall be avoided.</p> <p>d) Concrete shall not be placed in foundations on soft areas or where there is standing water or debris. Such soft areas shall be removed and filled with 1:3:6 nominal mix concrete, as directed by the Engineer-in-Charge.</p> <p>e) For rock surfaces, it shall be ensured that the rock is not unsound. On sloping rock faces, rough steps or beaches shall be formed and concrete shall not be placed on a sloping rock surface. Prior to pouring concrete, the rock surface shall be cleaned with a high pressure water and air jet and kept wet for three hours. Also, before placing concrete, water shall be removed from depressions, the rock surface shall be dried and a 10 mm thick cement sand mortar (1:6)-layer shall be placed and worked into all crevices, cracks, depression, etc.</p> <p>f) The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. Concrete shall be placed in continuous horizontal layers of 150mm or higher thickness as directed by the Engineer-in-Charge and thoroughly compacted before placing next layer. The thickness of each layer shall be such that it will be deposited before the previous layer has stiffened. When placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregates.</p> <p>g) Approval by the Engineer-in-Charge of any of the materials and/ or work as</p>

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	<p>required herein shall not relieve the Contractor of his obligation to produce finished concrete in accordance with the drawings and specifications. Slots, openings, holes, pockets etc. shall be provided in the concrete as directed by the Engineer-in-Charge.</p> <p>h) Slabs, beams and similar members shall normally be poured in one operation, In special circumstances, with the approval of the Engineer-in-Charge, these can be poured in horizontal layers, but it must be ensured that the under layer is not already hardened. Bleeding of under layer, if any, shall be effectively removed. Moulding, throating, drip course, etc. shall be poured as shown on the drawings or as desired by the Engineer-in-Charge.</p> <p>i) After the concrete has been placed, it shall be spaded and thoroughly compacted by approved mechanical vibrators to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete.</p> <p>j) Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall receive special consideration to ensure efficient compaction and to avoid surface blemishes. Surface vibrators and form attached vibrator shall not be permitted under normal conditions. Their use shall require written approval of the Engineer-in-Charge.</p> <p>k) Vibrators shall penetrate both the layer poured and the under layer to ensure good bond and homogeneity and to prevent the formation of cold joints. Immersion vibrators shall not be allowed to come in contact with steel reinforcement after start of initial set. Also, they shall not be allowed to come in contact with forms or finished surfaces.</p> <p>l) Immersion vibrators shall have a 'no load' frequency, amplitude and acceleration as per IS: 2505 depending upon the size of the vibrator. Immersion vibrators shall be operated by experienced men. These vibrators shall be immersed not more than 450mm apart and withdrawn when air bubbles cease to come to the surface. Such vibrators shall in no case be used to push concrete inside the forms and vibrators shall be withdrawn slowly.</p> <p>m) No concrete shall be placed in wet weather or on a water covered surface. If there has been any sign of washing of cement or sand, the concrete shall be entirely removed immediately. Suitable precautions shall be taken in advance to guard against possible rains before leaving the fresh concrete unattended.</p> <p>n) Mass concrete shall be poured in lifts not exceeding 1.0m in height unless otherwise indicated on drawings or as directed by the Engineer-in-Charge. Horizontal lift shall not be more than 150cm in thickness, according to provision of IS: 457.</p> <p>o) Formwork and reinforcement shall be approved in writing by the Engineer-in-Charge before concrete is placed. Concrete shall be placed only after all preparations for casting have been approved by the Engineer-in-Charge and approval given to proceed with the casting in writing on pour card to be</p>

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	<p>maintained by the Contractor for this purpose and to be submitted alongwith the Contractor's bills.</p> <p>p) Concrete, when deposited, shall have a temperature of not less than 5 degrees Centigrade and not more than 40 degree Centigrade. When depositing concrete in very hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 40 degrees Centigrade while placing. This shall be achieved by stacking aggregates under the shade and keeping them moist, using cold water, reducing the time between mixing by sprinkling water, starting curing before concrete dries out, etc. However, before mixing/placing concrete, when the above temperature conditions vary on either side, approval of the Engineer-in-Charge shall be obtained for the method of execution.</p>
2.05.08	Protection and Curing of Concrete
	<p>a) Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below ground level, shall be protected from falling earth, during and after placing. Concrete placed in ground containing any deleterious substances, shall be kept free from contact with such ground or with water draining from such ground, during placing of concrete and for a period of atleast three days or as otherwise instructed by the Engineer-in-Charge.</p> <p>b) The ground water around newly poured concrete shall be kept down to an approved level by pumping or other approved means of drainage. Adequate steps shall be taken to prevent floatation or flooding. Steps, as approved by the Engineer-in-Charge, shall be taken to protect immature concrete from damage by debris, excessive loading, vibration abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.</p> <p>c) As soon as the concrete has hardened sufficiently for the surface not to be marked, it shall be kept in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, hessian or similar materials and kept continuously wet for at least seven days after final setting. This period may be extended, at the discretion of the Engineer-in-Charge, up to fourteen days. Curing of horizontal surfaces exposed to drying winds shall begin immediately after the concrete has hardened. Concrete slabs and floors shall be cured for the periods mentioned above by flooding with water of minimum 25mm depth.</p> <p>d) Approved curing compounds may be used in lieu of moist curing with the permission of the Engineer-in-Charge. However, such permission may be granted only in specific cases. Such compounds shall be applied to all exposed surfaces of the concrete, as soon as possible after the concrete has set.</p> <p>e) Quantity of water applied shall be such as to prevent erosion of freshly placed concrete.</p>
2.05.09	Construction Joints
	<p>a) When work has to be interrupted, the concrete shall be rebated and/or keyed at the joint to such shape and size as may be required by the Engineer-in-Charge or as shown on the drawings. All vertical construction joints shall be made with</p>

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	<p>stop boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. In the case of water retaining structures, basements, tunnels, etc. water stop of approved material shall be provided, if so specified on the drawings or as directed by the Engineer-in-Charge.</p> <p>b) Construction joints shall be located as shown or described on the drawings. Where it is not described, the joints shall be in accordance with the following guidelines.</p> <ul style="list-style-type: none"> (i) Formed about 75mm below the lowest soffit of the beams framing into it, including haunches, if any. In flat slab construction, the joint shall be 75 mm below the soffit of the column capital. (ii) Concrete in a beam shall be placed throughout without a joint. If unavoidable, the joint shall be vertical and within the middle-third of the span. When a beam intersects a girder, the joints in the girder shall be given an offset equal to a distance twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member with suitable shear keys. (iii) A joint in a suspended floor slab shall be vertical at one quarter points of the span and at right angle of the principal reinforcement. (iv) Construction joints in equipment foundations shall not be provided without specific concurrence of the Engineer-in-Charge. (v) Vertical construction joints in water retaining structures shall not be permitted unless shown on the drawings. However, if the Contractor desires any adjustments in the location of construction joints (to suit site conditions) from those shown on drawings or from those explained above he shall obtain prior approval from the Engineer-in-Charge. <p>Skin of the partially hardened concrete which was poured earlier, shall be thoroughly removed and the surface made rough and aggregate exposed, by wire brushing, hacking, water jetting, air jetting or any other method as directed by the Engineer-in-Charge. The rough surface shall be thoroughly wetted for about ½ hour and shall be dried and coated with 10 to 15mm thick layer of 1:1 freshly mixed cement and sand slurry. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer.</p> <p>c) In forming a joint, concrete shall not be allowed to slope away to a thin edge. The locations of construction joints shall be planned by the contractor well in advance of pouring and they will have to be approved by the Engineer. The Contractor's proposals shall include atleast the location of construction joints, the sequence of pouring, formwork details and their stripping times.</p> <p>d) Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, a layer of concrete not exceeding 150mm in thickness shall first be placed and shall be well rammed against old work, particular</p>

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	<p>attention being paid to corners and close spots. Work, thereafter, shall proceed in the normal way.</p> <p>e) For multiple lift work, a suitable gap shall be maintained between the setting of the earlier placed concrete and the commencement of next concrete pour. After depositing concrete in columns, piers or walls, a time gap of minimum 4 hours, preferably 24 hours shall be maintained, before depositing concrete in beams, girders or slabs, supported thereon, in order to avoid cracking due to settlement.</p>
2.05.10	<p>Work in Extreme Weather Conditions</p> <p>Above 40 degree centigrade or cold weather (atmospheric temp at 5 degree centigrade and below) the concreting shall be done as per the procedures and precautions set out in IS: 7861 (Parts I and II).</p>
2.05.11	<p>Cleaning and Finishing of Concrete</p> <p>a) All concrete surfaces shall have an even and clean finish free from honeycombs, air bubbles, fins or other blemishes unmarred, reasonably smooth. The formwork joint marks on concrete work exposed to view shall be rubbed with carborandum stone and defects patched up with a paste of cement sand mortar (1:2) and cured. The finish shall be made to the satisfaction of the Engineer-in-Charge. Concrete surfaces to be subsequently plastered or where brick work is to be built against them, shall be adequately hacked as soon as the form is stripped off so that proper bond can develop.</p> <p>b) Immediately after removal of forms, the concrete shall be inspected and defective areas as pointed out by the Engineer-in-Charge shall be removed partially or entirely as directed. Holes, left by form bolts, etc. shall be filled up and made good with cement sand mortar of approved mix. All superficial defects such as honeycombing, rough patches, etc. shall be similarly made good. If the defective area is at a vulnerable location, e.g., at the ends of beams and columns, etc. then it may be necessary to cut out the member completely or in part and reconstruct as directed by the Engineer-in-Charge. If epoxies have to be used, the same shall be subject to the approval of the Engineer-in-Charge. Poured concrete affected by faulty formwork shall be removed totally and replaced. If so directed, the Contractor shall have to resort to grouting.</p> <p>c) A smooth finish shall be obtained with the use of forms having smooth and even surfaces and edges. Panels and form linings shall be uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothed off and all blemishes, projections etc. removed leaving the surfaces reasonably smooth and unmarred.</p> <p>d) Where integral cement concrete finish is called for, the surface shall be compacted and then floated and treated with a straight edge and any high and low spots eliminated. The work shall be carried out as per IS: 2571.</p>
2.06.00	<p>SAMPLING, TESTING AND QUALITY ASSURANCE INCLUDING CONSTRUCTION TOLERANCES</p>

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2.06.01	<p data-bbox="386 338 483 365">General</p> <ul style="list-style-type: none"> <li data-bbox="386 394 1459 489">a) Concrete cubes for works tests shall be cured under laboratory conditions, except when in the opinion of the Engineer-in-Charge, extreme weather conditions prevail at which time, these may require curing under job conditions. <li data-bbox="386 510 1459 699">b) For the purposes of statistical analysis, any substandard cube result, which in the opinion of the Engineer-in-Charge, is due to improper sampling, moulding or testing shall be discarded and a dummy result shall be substituted. The value of a dummy result shall be equivalent to the average value of the cubes from the same grade of concrete tested immediately before and after the discarded result. The number of such substandard cubes shall not exceed 5%. <li data-bbox="386 720 1459 846">c) If the 'strength' of the laboratory controlled cubes, for any portion of the concrete work, falls below the compressive strength specified, the Engineer-in-Charge shall have the right to order a change in the proportions or the water content for the remaining portion of the structure. <li data-bbox="386 867 1459 1129">d) If the 'strength' of the works cured test cubes falls below the specified strength, the Engineer-in-Charge shall have the right to require provisions for temperature and moisture control during the period of curing as necessary to secure the required strength, and may require retests in accordance with the standard method of curing, preparing and testing specimens from hardened concrete for compressive and flexural strengths, or load tests to be made on the portion of the building so affected. All such tests shall be made at the Contractor's expense. <li data-bbox="386 1150 1459 1339">e) Unacceptable concrete works shall be dismantled by the Contractor and replaced by fresh work, meeting the specification requirements at the contractor's own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, by the Contractor, to the satisfaction of the Engineer-in-Charge, at no extra cost to the Owner. <li data-bbox="386 1360 1459 1455">f) Before placing concrete, the inside of forms shall be checked to ensure that they are clean and thoroughly wetted or adequately treated, so as to prevent absorption of water from the concrete. <li data-bbox="386 1476 1459 1707">g) Ultrasonic tests on the foundations of major equipment to ascertain the quality and grade of concreting shall be carried out. Contractor shall at his own cost arrange for the specialised agency for conducting the test at his cost. The Contractor shall provide all the necessary facilities and arrangement for conducting the test at site in terms of access, scaffolding etc. In case of any defects, the Contractor shall rectify the same as directed by the Engineer-in-Charge. <li data-bbox="386 1728 1459 1791">h) Rebound hammer test shall be carried out for ascertaining the quality of concrete work, as directed by the Engineer-in-Charge. <li data-bbox="386 1812 1459 1906">i) Test shall be conducted for the water tightness of the liquid retaining structures as per IS: 3370 and IS: 6494. The details and sequence of tests shall be as given hereunder :

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	<p>(i) All arrangements, including supply of water for testing purposes, shall be kept ready when the tank is nearing completion.</p> <p>(ii) Water supply to the tank shall be in stages of 300 to 450mm height in order to check the water tightness of the tank and location of leakage of various levels.</p> <p>(iii) The permissible drop in level in 24 hours shall be 6mm in case of covered reservoir/tank and 12mm in the case of open reservoir/tank.</p> <p>(iv) The leakage points shall be marked and separately treated after dewatering.</p> <p>(v) The reservoir/tank shall be retested for water tightness after rectification.</p> <p>For basement type structures like cable-vault, tunnel, neutralising pit, etc. the Contractor shall carry out test for water tightness against ingress of sub-soil water.</p> <p>Frequency of sampling and testing including the methods for conducting the tests shall be as given in Table-4. All tests shall be carried out by the contractor at his own cost except specified otherwise.</p>
2.06.02	<p>Sampling of Concrete</p> <p>a) Normally only compressive test shall be performed but the Engineer-in-Charge may require other tests to be performed in accordance with IS:516.</p> <p>b) (i) Trial Mixes :</p> <p>Atleast three trial mixes shall be made with' min. 6 test cubes for each mix.</p> <p>(ii) Works Tests :</p> <p>The minimum frequency of sampling of concrete of each grade shall be according to clause 14.2.2 of IS:456. However, after getting continuous satisfactory results and in the case of voluminous concrete works, the Engineer-in-Charge may at his discretion reduce the frequency of sampling as follows.</p> <p>For each grade of concrete, and for each 8 hours (shift) of work or part thereof, atleast one sample consisting of six specimens shall be taken 120 cu.m. of concrete or part thereof, 3 specimens shall be tested at 7 days and remaining 3 shall be tested at 28 days. However, in all cases, the 28 days compressive strength shall alone be the criterion for acceptance or rejection.</p> <p>c) To control the consistency of concrete from every mixing, slump tests and compaction factor tests in accordance with IS: 1199 shall be carried out by the Contractor every two hours or as directed by the Engineer-in-Charge. Slumps corresponding to the test specimens shall be recorded for reference.</p>
2.06.03	<p>Unless otherwise specified, the tolerance in construction shall be as follows :</p>

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	Description of Item/Structural element	Permissible Deviation in mm	
	The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerance given below :		
	Faces of concrete in foundations and structural members against which backfill is placed.	+25	-10
	Location of footing (for RCC framed structures only).	+25	-25
	Eccentricity of footing.		2% of Footing width of direction of misplacement but limiting to 50mm.
	Top surfaces of slabs and of concrete to receive base plates to be grouted.	+5	-5
	Alignment of beams, lintels, columns, walls, slabs and similar structural elements.	+5	-5
	Cross sectional dimensions of beams, columns, walls, slabs and similar structural elements.	+5	-5
	Alignment of holding down bolts without sleeves.	+1.5	-1.5
	Description of Item/Structural element	Permissible Deviation in mm	
	Alignment of holding down bolts with sleeves.	+5	-5
	Level of holding down bolt assemblies.	+10	-10
	Embedded parts (in any direction).	+5	-5
	Centres of pockets or holes with greatest lateral dimension not exceeding 150mm.	+10	-10
	Variation in steps		
	Riser	+1.5	-1.5
	Tread	+3.0	-3.0
	Plumb	3mm for every meter (maximum + 10mm for the complete structure)	
2.06.04	Acceptance Criteria		
	The acceptance criteria of concrete shall be in accordance with clause no. 15 of IS: 456. However, in exceptional circumstances, the Engineer-in-Charge may, at his discretion, accept a concrete of lower strength than that specified at reduced rates.		
2.06.05	Inspection and Testing of Structures		

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The work will be properly inspected by the Engineer-in-Charge. In case of doubts, the owner shall carry out core tests as per IS: 456. If any work is found unacceptable whereupon the Engineer-in-Charge requires its removal and reconstruction, the Contractor may request that it should be load tested at his own risk and cost in accordance with the provision of IS: 456.

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SECTION – 3	
3.00.00	REINFORCEMENT
3.01.00	SCOPE
	This section of the specification deals with reinforcement for all reinforced concrete works and covers the requirement of materials, their properties, storage, handling, furnishing of bar bending schedules and the cleaning, bending, binding and placing of reinforcement with suitable cover blocks. This shall also include the supply of reinforcement, wherever required.
3.02.00	GENERAL REQUIREMENT
3.02.01	The Contractor shall prepare and furnish to the Engineer-in-Charge, bar bending schedules for all RCC works for his review and approval. No work shall commence without the approval of bar bending schedules by the Engineer-in-Charge, in writing.
3.02.02	The Contractor shall have to obtain prior written approval from the Engineer-in-Charge, if he desires any adjustments in diameter or spacing of reinforcement. However, the Contractor shall modify the bar bending schedule, when a particular type and size of reinforcement would not be available, with the approval of the Engineer-in-Charge.
3.03.00	MATERIALS
3.03.01	All steel for reinforced concrete works shall be in accordance with Technical Specification for Properties, Storage and Handling of common Building Materials which shall be deemed to form the part of this specification.
3.03.02	All bars shall be thoroughly cleaned before being fabricated. Pitted and defective bars shall not be used.
3.04.00	BENDING AND PLACING
3.04.01	Fabrication
a)	All bars shall be cut and bent in accordance with the bar bending schedules made by the Contractor which have been previously approved by the Engineer-in-Charge.
b)	Reinforcing steel bars shall be cut and bent on the Site of the Works or at a fabricator's plant. Notwithstanding the above, a bar-bending machine and a representative stock of reinforcing steel shall be maintained on the Site, sufficient to allow minor revisions and additions to be carried out as required by the Engineer-in-Charge.
c)	Reinforcing steel shall not be straightened or re-bent in a manner that will damage the materials. Bars with kinks or bends other than those indicated on

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	<p>the drawings and schedules shall not be used.</p> <p>d) Shorter lengths of steel shall not be used in places where continuous lengths are required as per the drawings without the approval of the Engineer-in-Charge. Shorter bars, if approved for use, shall be lapped or spliced to achieve continuity in accordance with the requirements of relevant Indian Standards or as approved by the Engineer-in-Charge.</p> <p>e) Bars shall be bent cold to the shape and dimensions shown on the drawings using a bar bender operated by hand or power to attain the proper radii of bends.</p> <p>f) A standard 180 degree hook at the end of a reinforcement bar, if used, shall have an inner diameter not less than six times the diameter of the bar, up to a bar or 25mm diameter, and shall have length of straight part beyond the curve of at least four times the diameter of the bar. Hook shall be used only where shown on drawings or as required by the Engineer-in-Charge. The radii of bends for stirrups and ties shall not be less than four times the diameter of the bar for up to bars 16mm in a diameter, and six times the diameter for bars up to 25mm diameter.</p> <p>g) Heating of reinforcement bars to facilitate bending shall not be permitted.</p> <p>h) The reinforcement available from rejected reinforced concrete shall not be used without prior approval of the Engineer-in-Charge.</p>
3.04.02	<p>Splicing of Reinforcement Bars</p> <p>a) Where ever it is necessary to splice reinforcement, the splices shall be made by lapping, or by mechanical means.</p> <p>b) The steel bars shall be joined by providing lap joints in accordance with the requirements of the relevant Indian Standards or as approved by the Engineer-in-Charge. Splices at points of maximum stress shall however, be avoided. Splices in adjacent bars shall be staggered as directed by the Engineer-in-Charge. Lap length of bars shall be as shown on the drawings and as per Indian Standards. This length may be changed by the Engineer-in-Charge in special locations.</p> <p>c) If the contractor proposes to use welded splices in the reinforcing bars, the equipment, the materials and all welding and testing procedures shall be subject to the approval of the Engineer-in-Charge. The contractor shall carry out test welds as required by the Engineer-in-Charge.</p> <p>d) For welded splices for reinforcing bars, welding shall be done in accordance with relevant Indian Standard Codes. Electrodes for welding shall conform to relevant Indian Standards. But welding shall be done only to reinforcement bars of weld able grade.</p> <p>e) If the Contractor proposes to use mechanical couplings for reinforcing bars, he shall submit samples of the proposed coupling to the Engineer-in-Charge for approval prior to their proposed use.</p>

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	<p>f) Lap splices shall not be used for bars larger than 36mm diameter, which may be welded with the approval of the Engineer-in-Charge. In cases where welding is not practicable, lapping of bars larger than 36mm may be permitted, in which case, additional spirals shall be provided around the lapped bars. Where welding is approved, the Contractor shall prepare at least three samples of butt welds as directed by the Engineer-in-Charge. These specimens shall undergo tests by the Contractor in a recognised laboratory. If the results are satisfactory, the Engineer-in-Charge may allow welding instead of lap joints. The decision of the Engineer-in-Charge in this regard shall be final. The joint shall be butt welded by the electric-arc-method. The ends of the bars shall be cleaned of all loose scale, rust, grease, or other foreign materials and all welding shall conform to the relevant Standard Specifications for welding of reinforcement bars used in reinforced concrete construction or as directed by the Engineer-in-Charge.</p> <p>g) A weld shall be considered unsatisfactory if it fails to sustain a tensile stress of at least 90% of the tensile strength of the bar in which the weld has been made.</p>
3.04.03	<p>Placing</p> <p>a) Before being placed in position, the reinforcing steel shall be thoroughly cleaned of loose mill scale and rust, grease, paint, or other coatings that would reduce bond. All splashed concrete, which has dried on the reinforcing steel, shall be removed.</p> <p>b) Reinforcing steel to be incorporated in the Works shall be placed accurately in positions as shown on the drawings and shall be held firmly in place during the placing and setting of the concrete.</p> <p>c) Reinforcing steel shall be so placed that there will be a clear distance of at least 50mm between the reinforcing steel and anchor bolts or embedded metal work.</p> <p>d) Reinforcing steel shall be maintained in position by the use of small concrete blocks, steel chairs, steel spacers, steel hangers and other steel supports and ties, acceptable to the Engineer-in-Charge at sufficiently close intervals so that they do not either sag between supports or be displaced during placing of concrete or by any operation on the Work. Wood supports or spreaders shall not be used. All intersections shall be securely tied except that where the bar spacing is less than 300mm in each direction, only alternate intersections need be tied.</p> <p>e) Binding wire and steel chairs shall not be carried to permanently exposed surfaces and shall be subject to the same requirements with regard to concrete cover as for the reinforcing steel.</p> <p>f) Special care shall be exercised to prevent any disturbances of the reinforcement in concrete that has already been placed. The reinforcement after being placed in position shall be maintained in a clean condition until it is complete embedded in concrete.</p>

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g)	The longitudinal bars shall be straight and fixed parallel to each other and to the sides of the form as shown on the drawings. The ties, links and stirrups connected to the bars shall be tightly fixed so that the bars are properly braced. The inside of their curved part shall be in actual contact with the bars around which they are fixed and their position shall be exact as shown on the drawings.
h)	Wire for tying reinforcement shall be black annealed iron wire. The diameter of wire shall not be less than 1.6mm and shall have an ultimate strength of 5.63 tonnes per cm ² and yield point of not less than 3.87 tonnes per cm ² .
i)	"Bar-Grip" type joints shall be adopted by the Contractor for deformed bars of 25mm diameter and above, subject to the approval of the Engineer-in-Charge. Splices at points of maximum stress shall however, be avoided. Splices in adjacent bars shall be staggered as directed by the Engineer-in-Charge. Lap length of bars shall be as shown on the drawings and in accordance with IS standards. This length may be changed by the Engineer-in-Charge in special locations.
j)	Sufficient concrete cover, as indicated on the drawings shall be provided to protect reinforcement from corrosion. All protruding bars from concrete to which other bars are to be attached and which shall be exposed to action of the weather for long period shall be protected from rusting by a thin coat of neat cement grout. Accurate record shall be kept at all the times of the number, sizes, lengths and weights of bars placed in position for different parts of the Work.
k)	The Contractor shall avoid the use of two different grades of steel for one construction object.
3.04.04	<p>Care of placed reinforcement and Concrete</p> <p>Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care shall be taken to ensure that at no time the radius of the bend is less than 8 diameters for deformed bars and 6 diameters for plain mild steel bars. Care shall also be taken, when bending back bars, to ensure that the concrete around the bar is not damaged.</p>
3.05.00	COVER TO REINFORCEMENT
3.05.01	<p>a) Unless shown otherwise on the drawings, minimum clear concrete cover for reinforcement (exclusive of plaster or other finishes) shall be as follows :</p> <ul style="list-style-type: none"> - At each end of a reinforcing bar, not less than 25mm, nor less than twice the bar diameter. - For a longitudinal reinforcing bar in a column, 40mm or bar diameter whichever is more. 25mm cover may be adopted for columns of minimum dimension 200mm or under and with longitudinal reinforcement diameter not exceeding 12 mm. - For longitudinal reinforcing bars in a beam, not less than 25mm or less than the bar diameter.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 04	
4.00.00	FORMWORK AND STAGING
4.01.00	SCOPE
	Requirements for the supply, erection, dismantling of formwork and staging required for cast-in-situ concrete works including for making pockets / block outs.
4.02.00	GENERAL REQUIREMENTS
4.02.01	The contractor shall supply, fabricate, erect and dismantle (after use) all staging that is required for all activities covered under the specifications. He shall prepare the scheme and submit alongwith the supporting calculations for approval of the Engineer-in-Charge.
4.03.00	MATERIALS
4.03.01	Formwork shall compose of steel, best quality wood or non-absorbent type plywood. Timber shall be free from significant knots and shall be of medium grain as far as possible and hard woods shall be used as caps and wedges under or over posts. Timber shall be well seasoned, free from sap, shakes, worm holes, warps or other surface defects and shall have smooth finish.
4.03.02	Staging, unless specified otherwise, shall generally be of mild steel tubes, steel beams and channels etc. or strong sal ballies 150 mm in diameter or above. Bamboos, small diameter ballies etc., shall not be used unless approved by the Engineer-in-Charge in specific cases.
4.04.00	CLASSIFICATION OF FORMWORK
4.04.01	<p>a) Ordinary: This shall be used in places where ordinary surface finish is required and shall compose of steel and/or approved good quality seasoned wood. Plywood shuttering can also be used by the Contractor.</p> <p>b) Plywood: This shall be used in exposed surfaces as shown on drawings or as directed by the Engineer-in-Charge where a specially, good finish is required. Such surfaces shall be formed using approved brand or heavy quality water resistant plywood to produce a perfectly levelled, uniform and smooth surface. Reuse of such forms may be permitted only after inspection and approval by the Engineer-in-Charge, for each such reuse.</p>
4.05.00	QUALITY OF FORMWORK AND STAGING
4.05.01	Formwork shall consist of all materials required for forming the boxing to pour concrete, including steel/wood/plywood forms, ties, anchors, hangers, inserts, etc. Formwork shall be so constructed that vertical and horizontal adjustments can be made as

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	required. The design and engineering of formwork including staging as well as its erection and dismantling shall be the responsibility of the Contractor.
4.05.02	The staging shall be true and rigid and thoroughly braced in both directions as well as cross braced, strutted and propped such that it will not deform unduly under weight of concrete and other loads due to men, equipment, etc. Vertical members or props should not be supported on an un-propped lower suspended floor or beams unless it is ensured by the Contractor that the lower floor or beam can safely carry the loads. No propping shall take place until the approval of the Engineer-in-Charge has been given to the Contractor's scheme submitted along with supporting calculations.
4.05.03	The forms and staging shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as anticipated working loads. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration, without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete, must be brought to the notice of the Engineer-in-Charge immediately and rectified as directed by him.
4.05.04	To achieve the desired rigidity, ample stud, braces, bolts, spacer blocks, wires, clamps, ties, straps, shores, etc. shall be used to hold the form in proper position without undue distortion. These shall be approved by the Engineer-in-Charge but they must in no way impair the strength of concrete or leave stains or marks on the finished surface. Where there are chances of these fixtures being remain embedded, only mild steel shall be used, all projections shall cut removed and flushed with surface with plaster of 1:4 mix. Bolts passing completely through liquid and or earth retaining walls/slabs, basement walls etc. for the purpose of securing and aligning the formwork shall not be permitted.
4.05.05	For exposed interior and exterior concrete surfaces of beams and columns, plywood or other approved forms thoroughly cleaned and tied together with approved corrosion resistant devices shall be used. Extreme care shall be exercised ensuring that all column forms are plumb and true and thoroughly cross braced to keep them in required position.
4.05.06	Bevelled strips 25x25 mm shall be provided to form angles and in corners of columns and beam boxes for chamfering of corners if shown on drawings or directed by the Engineer-in-Charge. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where these are necessary and as may be directed by the Engineer-in-Charge. The temporary openings shall be so formed that they can be conveniently closed rigidly when required and must not leave any mark on the concrete.
4.05.07	If it is so desired by the Engineer-in-Charge, the Contractor shall prepare, before commencement of the actual work, designs and drawings for formwork and staging and get them approved by the Engineer-in-Charge. Formwork shall be so designed and

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
	positioned that it can be removed without damage to concrete.
4.05.08	The Contractor shall maintain necessary camber in centering for all floor slabs and beams in all spanning directions, so as to offset the deflection and assume correct shape. The chamber shall have the crown of not less than 8mm for every 5 metres span unless otherwise shown on the drawings. For cantilever, camber at free end shall be 1 in 100.
4.05.09	The Contractor shall provide the shuttering for complete stretch of work upto expansion joints for the structures like shell, folded plate etc. and/or as directed by the Engineer-in-Charge.
4.06.00	CLEANING AND TREATMENT OF FORMS
4.06.01	All forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, direct and dust sticking to them before these are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Wire brushes, brooms, compressed air jet and/or water jet etc. shall be kept handy for cleaning, if directed by the Engineer-in-Charge.
4.06.02	Before formwork is placed in position, the form surfaces that will be in contact with concrete shall be treated with approved non-staining oil or composition which is insoluble in water and not injurious to concrete. Care shall be taken that the oil or composition does not come in contact with reinforcing steel or stain the concrete surfaces. Burnt oil shall not be allowed to be used especially where the concrete surface will require finishing and/or plaster.
4.07.00	REMOVAL OF FORMS
4.07.01	The Contractor shall begin the removal of formwork only after approval of the Engineer-in-Charge. He shall place on record the dates on which the concrete is placed in different parts of the work and the dates of the removal of formwork there from. This record shall be checked and countersigned by the Engineer-in-Charge. The Contractor shall be responsible for the safe removal of formwork but the Engineer-in-Charge may delay the time of removal if he considers it necessary. Any work showing signs of damage through premature removal of formwork, shall be entirely removed and reconstructed by the Contractor at no extra cost to the Owner.
4.07.02	The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls may be removed first, leaving the beam bottoms and their supports in position. Re-propping of beams shall not be done except with the approval of the Engineer-in-Charge. Formwork for columns and walls at each stage of concreting shall be erected only upto the particular lift of construction. Wedges, spacer bolts, claps or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jerking the concrete.
4.07.03	Forms of various types of structural components shall, under normal circumstances,

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	<p>not be removed before the minimum periods specified in Cl. 10.3 of IS: 456, which shall also be subject to the approval of the Engineer-in-Charge. However, in any case formwork shall not be struck until the concrete has reached strength, atleast twice that of the stress to which the concrete may be subjected to at the time of removal of forms.</p> <p>In normal circumstances and where ordinary Portland cement is used, forms may generally be removed after the expiry of the following periods, according to clause no. 10.3 of IS:456.</p>		
	i)	Walls, columns and vertical faces of all structural members as directed by the Engineer-in-Charge.	: 1 to 2 days
	ii)	Slabs (Props left under)	: 3 days
	iii)	Beam soffits (props left under)	: 7 days
	iv)	Removal of props under slabs	
		Spanning upto 4.5m	: 7 days
		Spanning over 4.5m	: 14 days
	v)	Removal of props under Beams	:
		Spanning upto 6 m	: 14 days
		Spanning over 6 m	: 21 days
	vi)	Cantilever Slabs	: 14 days
4.07.04	The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.		
4.07.05	Where the shape of the element is such that the formwork has re-entrant angles, the formwork shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.		
4.07.06	In case of cantilever slabs, the removal of forms shall begin from the outer edge and proceed towards the support, where as in the case of slabs supported on two/four sides, the removal of forms shall begin from centre to supports.		
4.07.07	The formwork shall be so made as to produce a finished concrete, true to shape, lines, plumb and to dimensions as shown on the drawings. The Engineer-in-Charge may call for finished work at any time to set standards of workmanship. Once approved, these will become the accepted sample.		
4.07.08	In case PPC/PSC is used instead of OPC, the removal of shuttering/support shall be delayed by additional 50% time from that being applied for OPC, unless otherwise permitted by the Engineer-in-Charge. For concrete temperature above 40°C, stripping		

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS													
	time shall be increased.													
4.08.00	REUSE OF FORMS Before reuse, all forms shall be thoroughly scraped, cleaned, all nails and adhering substances removed, holes and leaks satisfactorily plugged, joints examined and where necessary repaired and inside surfaces treated as specified herein before. Formwork shall not be used/ reused, if declared unfit or unserviceable by the Engineer-in-Charge.													
4.09.00	TESTING AND QUALITY ASSURANCE (INCLUDING DIMENSION TOLERANCE)													
4.09.01	General Staging shall be checked for its soundness as a whole and for adequacy of the joints and its foundations. Formwork joints shall be inspected for soundness of connections. All joints shall be either vertical or horizontal and shall be such as to avoid loss of liquid through the formwork.													
4.09.02	Dimensional Tolerance for formwork <table><tr><td>Levels and heights Plumb</td><td>:</td><td>$\pm 5\text{mm}$, 3mm for every metre, 10mm (max) for the complete structure</td></tr><tr><td>Unevenness of any surface</td><td>:</td><td>$\pm 3\text{ mm}$</td></tr><tr><td>Length or breadth</td><td>:</td><td>$\pm 12\text{ mm}$</td></tr><tr><td>Diagonals</td><td>:</td><td>$\pm 15\text{ mm}$</td></tr></table> In addition to above, requirement of clause no. 11.3 shall be complied with, which shall be the final acceptance criteria of concrete work.		Levels and heights Plumb	:	$\pm 5\text{mm}$, 3mm for every metre, 10mm (max) for the complete structure	Unevenness of any surface	:	$\pm 3\text{ mm}$	Length or breadth	:	$\pm 12\text{ mm}$	Diagonals	:	$\pm 15\text{ mm}$
Levels and heights Plumb	:	$\pm 5\text{mm}$, 3mm for every metre, 10mm (max) for the complete structure												
Unevenness of any surface	:	$\pm 3\text{ mm}$												
Length or breadth	:	$\pm 12\text{ mm}$												
Diagonals	:	$\pm 15\text{ mm}$												
4.09.03	Frequency of sampling and testing of work shall be as per Table-4.													

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 05	
5.00.00	EMBEDDED PARTS
5.01.00	SCOPE This section of specification deals with the supply, fabrication (where called for) and/or erection of embedded steel parts and PVC pipes.
5.02.00	GENERAL REQUIREMENTS
5.03.00	Embedded steel parts shall be supplied, fabricated and erected by the Contractor as stipulated.
5.04.00	MATERIALS
5.04.01	The materials shall be in accordance with the relevant clauses of Technical Specification for properties, Storage and Handling of Common Building Materials which shall be deemed to form a part of this specification. Mild steel pipes shall conform to IS: 1161. Unless otherwise specified, medium class pipes shall be provided. PVC pipes shall conform to IS: 4985. Minimum pressure rating shall be 2Kg/cm ² .
5.05.00	FABRICATION, ERECTION ETC.
5.05.01	The Contractor shall fabricate, transport to site and erect accurately in position all embedded steel parts either by welding, bolting or any other means as approved by the Engineer-in-Charge. Exposed surfaces of embedded parts other than holding down bolts, unless otherwise stated, are to be painted with approved primer as per IS: 2074 with DFT 50 micron paint as directed. The threads of holding down bolts shall be greased and protected with waterproof tape.
5.05.02	During erection, the Contractor shall provide necessary strong temporary bracings and supports to ensure proper installation of the embedded parts which shall be erected at the true location as shown on the drawings and these shall be in plumb and level (unless otherwise shown on drawings). The Contractor shall furnish the Engineer-in-Charge with fabrication and assembly drawings prepared for embedded steel parts showing the erection procedure, for major items, wherever necessary.
5.05.03	Fabrication and erection shall be carried out as per IS: 800. Welding rods and site/field welding shall conform to IS: 816 and IS: 9595. IS: 7634 (part-III) shall be followed for PVC pipe works.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 06	
6.00.00	FOUNDATION BOLT ASSEMBLY
6.01.00	SCOPE
	This section of the specification deals with the requirements of supply, fabrication and erection of foundation bolt assembly, etc.
6.02.00	GENERAL REQUIREMENT
	Supply, fabrication, erection and installation of Foundation bolt assembly shall comprise of foundation bolts, stiffener plates, washer, nuts, lock nuts, pipe sleeves, etc.
6.03.00	MATERIALS
6.03.01	Foundation bolts shall generally conform to IS: 5624. Mild steel bars used for the fabrication of bolt assembly shall conform to grade-1 of IS: 432, IS: 226, IS: 2062 or any other material including high carbon/high tensile steel as specified.
6.03.02	Hexagonal nuts and lock nuts shall conform to IS:1363 and IS:1364 upto M 36 dia and IS:3138 for M42 to M150 dia.
6.03.03	Flat plain washers shall be of mild steel and punched/ machined type conforming to IS: 5369.
6.03.04	Steel pipe sleeves shall conform to Medium class of IS: 1161.
6.04.00	FABRICATION, ERECTION, ETC.
6.04.01	The fabrication and erection of bolt assemblies shall include threading, cutting, grinding, drilling, welding, etc. complete. All bolts, bolt assemblies, etc. shall be fabricated by the Contractor to the correct dimensions and shapes as shown on drawings, supplied by the Engineer-in-Charge. The bolts shall have coarse pitch screw thread in the diameter range, 8 to 64mm and 6mm pitch screw for diameter >64mm, as per IS:4218.
6.04.02	For fabrication of any particular size of bolt indicated on the drawing, the diameter of the threaded portion of the bolt shall be considered as the diameter of the bolt.
6.04.03	Fabrication and erection shall be carried out as per IS: 800. Welding shall conform to IS: 816 and IS: 9595.
6.04.04	Every bolt shall be provided with a steel washer, under the nut. The washer shall be flat and min outside inscribed circle has a diameter 2.50 times that of the bolt and of

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	<p>suitable thickness. All nuts shall be of steel with well formed hexagonal heads, unless specified otherwise, forged from solid metal and shall be dipped in hot boiled linseed oil as soon as these are made. The nuts shall fit well on the bolts.</p>
6.04.05	<p>During erection, the Contractor shall provide necessary temperature, temporary bracings, supports, etc. to ensure proper positioning of the assemblies and holding them firmly until they are cast/grouted and the grout has set. All materials shall be erected in plumb and in level (unless otherwise specified) and at true locations as shown on the drawings. Threads shall be protected by using PVC tape.</p>

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 07	
7.00.00	JOINTS IN CONCRETE
7.01.00	SCOPE
	This section of the specification deals with the requirement of furnishing and installing of joints including joint filler materials, water bars, resilient pads type vibration damping material in and around the sides of concrete works, etc.
7.02.00	GENERAL REQUIREMENTS
	Details of joints shall be as approved by Engineer-in-Charge or as per approved drawings. Where necessary or/and specified, joints shall be made water tight by use of water stops.
7.03.00	CLASSIFICATION OF JOINTS
7.03.01	From the point of view of utility, the joints as provided maybe classified as below : -
a)	Construction Joints: Construction joints are produced by placing fresh concrete against surface of hardened concrete. Construction joints are generally, but not necessarily, vertical or horizontal.
b)	Contraction Joints: These are provided to eliminate tensile stresses due to shrinkage and are commonly used where temperature variations are small and where there is no likelihood of expansion, such as spaces below water and earth levels and unexposed to atmosphere. At contraction joints, the reinforcement is discontinued and bond is not allowed to develop between the joint faces, thereby introducing a structural discontinuity. A contraction joint also serves as a construction joint so far as break in the pouring of concrete is concerned.
c)	Expansion Joints: These are provided either to completely eliminate or to significantly reduce compressive stresses in concrete that would otherwise result from thermal expansion and might crush, buckle or crack part of the structure. Expansion joints serve the purpose of contraction and also construction joints.
d)	Control Joints: At places where cracking is inevitable, places of weakness are introduced by the provision of control joints so that the cracking takes place along these joints instead of allowing it to develop in a haphazard manner.
e)	Separation Joints: The places where the expansion of the structure is not expected but they are required to be kept structurally separate so that stresses vibrations, etc. are not transferred, a separation joint should be provided. Like expansion joint, a gap is provided in separation joint also, but this is not expected to be used up by the expansion of members. In case, no gap is required, the separation joint can be obtained by using an approved alkathene

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	<p>sheet stuck on the surface against which concrete shall be placed.</p> <p>f) Settlement Joints: Structures, which are likely to settle with respect to the adjacent structures, shall be separated by a settlement joint so that the adverse effects of differential settlement are obviated. It is like an expansion joint but with a different sealing arrangement.</p>
7.04.00	MATERIALS
7.04.01	<p>Joint Filler :</p> <p>a) Bitumen Board: The bitumen impregnated fibre board; a preformed material shall be used as joint filler which shall fill space between the concrete surfaces at the joints. The minimum thickness of board shall be 12mm and the material shall conform to IS: 1838.</p> <p>b) Expanded Polystyrene: The expanded polystyrene slab shall be of fire retarding grade (type-2) conforming to IS: 4671. Density of material shall not be less than 25kg/cu.m.</p>
7.04.02	<p>Water stops</p> <p>a) Water stops shall be provided at the joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure.</p> <p>b) The water stops shall be either metallic like Copper, or non-metallic like P.V.C. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of Water Stops of similar make and shape for other jobs. Only PVC water stop shall be used, unless, otherwise, specifically approved by the Engineer-in-Charge.</p> <p>c) Non-metallic Water Stop : These will be normally in P.V.C. and can be of shape having any combination of the following features :</p> <ul style="list-style-type: none"> (i) Plain (ii) Central Bulb (iii) Dumb-bell or flattened ends (iv) Ribbed and Corrugated Wings (v) V-shaped (vi) Kicker type (Externally placed) <p>The minimum thickness of P.V.C. Water Stops shall be 5mm and the minimum width 225mm. The actual size and shape will be as shown on drawings and/or as directed by the Engineer-in-Charge. The material should be of good quality Polyvinyl Chloride, highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The performance requirements shall generally be as follows :</p>

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	<p>Sp. Gr. : 1.3 to 1.4</p> <p>Shore Hardness : 61A to 80A</p> <p>Tensile Strength : 116 kgf/cm² min.</p> <p>Maximum safe continuous : 70°C</p> <p>Temperature</p> <p>Ultimate Elongation : Not less than 300%</p> <p>Tear Resistance : 45kgf/cm² min.</p> <p>Stiffness in flexure : 25kgf/cm² min.</p> <p>Accelerated extraction</p> <p>i) Tensile strength : 110 kgf/cm²</p> <p>ii) Ultimate elongation : 250%</p> <p>iii) Water absorption in 7 days : 5% (max)</p> <p>Effect of Alkali : 7 days</p> <p>a) Weight increase : 0.25% max.</p> <p>b) Weight decrease : 0.10% max.</p> <p>c) Hardness change : $\pm 5\%$</p> <p>Effect of Alkali : 28 days</p> <p>a) Weight increases : 0.40% max.</p> <p>b) Weight decrease : 0.30% max.</p> <p>c) Dimension change : + 1%</p>
7.04.03	<p>Sealing Compound</p> <p>a) Bitumen Sealing Compound: The bitumen sealing compound shall be from approved manufacturer and shall conform to the requirements of IS:1834. For joints in concrete lining on canals / reservoirs, sealing compound conforming to IS: 5256 shall be used.</p> <p>b) Polysulphide Sealing Compound: This shall be two-part Polysulphide sealant and shall be from approved manufacture, conforming to IS: 12118. Materials shall consist of Polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.</p>
7.04.04	<p>Metal Cover Strips</p> <p>Metal cover strips shall be made form aluminium or mild steel sections as shown on drawings. The minimum thickness of aluminium strips shall be 3mm and that of mild steel 6mm. Aluminium alloy strip shall be corrosion resistant grade 31000 as per</p>

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
	IS:737. Mild steel shall conform to IS: 226 or IS: 2062.
7.04.05	Resilient Pads
	a) The vibration damping material shall be resilient rubber pads made up of natural or synthetic rubber and shall have the following physical properties :
	i) Shore 'A' durometer hardness 50 + 5
	ii) Minimum elongation 450%
	iii) Ultimate minimum tensile strength 145 kg/sq.cm.
	iv) Rubber pads shall not absorb more than 10% of weight of water in a 7 day test.
	b) The minimum thickness of the resilient pads shall be 12mm.
7.05.00	INSTALLATIONS
7.05.01	Bitumen Board / Expanded Polystyrene
	The bitumen impregnated fibre board may be secured to vertical concrete by nails in the first placed concrete. The joint filler shall be coated on both faces with coal-tar pitch conforming to IS: 216 or bitumen of suitable grade conforming to IS: 73 or IS:702.
7.05.02	(i) Water stops shall not have any longitudinal joints and shall be procured and installed in largest practicable lengths having a minimum number of transverse joints. The jointing procedure shall be as per the manufacturer's recommendations and shall be reviewed and approved by the Engineer-in-Charge. Suitable field splicing kit including heater shall be used for this purpose. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.
	(ii) As non-metallic Water Stops can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer-in-Charge. The method of forming these joints, laps, etc. shall be as specified by the Manufacturer and/or approved by the Engineer-in-Charge, taking particular care to match the centre and the edges accurately.
	(iii) Particular care shall be taken for the correct positioning of the water stops to prevent any faulty installation which may result in joint leakage.
	Adequate provisions shall be made to support the water stops during progress of work and to ensure their proper embedment in the concrete. The symmetrical halves of the water stops shall be equally divided between the concrete pours adjacent to the joints.
	Maximum density and imperviousness of the concrete shall be ensured by

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	<p>thoroughly working in the vicinity of joints. However, particular care should be exercised in use of vibrators in the proximity of joints to avoid dislodging of the water stops.</p> <p>(iv) Splices: Splices in the continuity of intersections of runs of water stops shall be jointed as per manufacturer's stipulations depending on the type of water stops used. In case of a cross section, overlapping must not be done but, instead factory made cross joint should be used. It is essential that the material is not damaged during the splicing operation and that the continuity of the entire water stops across the section be maintained.</p> <p>(v) Inspection: All water stops installations shall be subject to inspection and approval by the Engineer-in-Charge, before concreting operations, encasing water stops, are performed.</p>
<p>7.05.03</p>	<p>Sealing Compound</p> <p>When directed, the gap in joints shall be thoroughly cleaned and sealing compound laid as per manufacturer's specification and approved drawings, primer shall be applied wherever required. For reservoir/canal lining, procedure as stipulated under clause 9.0 of IS: 5256 be followed.</p>
<p>7.05.04</p>	<p>Metal Cover Strips</p> <p>The metal cover strips shall be pinned at one end and slotted at the other end. Exposed surface of mild steel shall be painted with two coats of approved anti-corrosive paint and/or bituminous paint. Welding of Aluminium shall be in accordance with IS: 2812.</p>
<p>7.05.05</p>	<p>Resilient Pads</p> <p>The resilient pads shall be installed around the foundations or at other locations as shown on the drawings. The pads shall be installed in position by sticking the same to the foundations by using an approved adhesive/ glue.</p>

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 08	
8.00.00	<p>WATER PROOFING OF WATER BEARING AND UNDERGROUND CONCRETE STRUCTURES</p> <p>Water proofing of water bearing and underground concrete structures shall be done by bitumen, suitable design of the concrete mix, addition of admixtures in the concrete at the time of mixing, installing water bars at the joints and providing treatment as per Clause 8.02.01 to 8.02.02. Addition of admixtures should not reduce the specified strength of concrete in any case.</p> <p>The materials shall conform to the respective IS code wherever applicable. The Contractor before procurement shall obtain the approval of the Engineer-in-Charge for the materials. If desired by the Engineer-in-Charge, test certificates for the materials shall be submitted by the Contractor and samples for testing shall be supplied free of cost. The materials shall be of best quality available indigenously, fresh and thoroughly clean.</p> <p>Contractor shall give a guarantee in writing for all works executed under this specification, supplemented by a separate and unilateral guarantee from the specialized agency for water-proofing treatment works. The guarantee shall be for 20 years. The mode of execution of the guarantee shall be acceptable to the Owner. Any other treatment required to make structures waterproof but not specified herewith shall also be provided.</p>
8.01.00	Joint Sealing Strips
8.01.01	<p>General</p> <p>Where shown on the drawing joint sealing strips shall be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strip shall be of Polyvinyl Chloride (PVC).</p> <p>Sealing strips shall not have any longitudinal joins and shall be procured and installed in largest practicable length having a minimum number of transverse joints. The material is to be procured from reliable manufacturer having proven records of satisfactory supply of joints strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary by the Engineer-in-Charge. The contractor is to supply all labour, material, and tools required for jointing, testing, protection, etc. Joints in rubber seals shall be vulcanized.</p>
8.01.02	<p>Non-Metallic Sealing Strips</p> <p>A) General</p> <p>These will be of Polyvinyl Chloride (PVC). PVC joint seals can be of shape having any combination of the following features.</p> <p>i) Plain</p>

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	<div><div><div>ii) Central bulb</div><div>iii) Dumb-bell or flattened ends</div><div>iv) Ribbed or corrugated wings</div><div>v) V-shaped</div></div><div>As these types of seals cannot be easily handled in very large length unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer-in-Charge. The method of forming all these joints, laps, etc shall be as specified by the Manufacturer and/or as approved by the Engineer-in-Charge taking particular care to match the central bulbs and the edges accurately.</div><div>B) PVC Sealing Strips</div><div>The minimum thickness of PVC Sealing strips will be 6 mm and the minimum width 230 mm. The actual size and shape will be as shown in drawings and/or as directed by the Engineer-in-Charge. The material should be good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with it during use. The physical properties will generally be as follows:</div><table><tr><td>Sp. Gr.</td><td>:</td><td>1.3 to 1.35</td></tr><tr><td>Shore Hardness</td><td>:</td><td>60A to 80A</td></tr><tr><td>Tensile Strength</td><td>:</td><td>>= 120kg/cm²</td></tr><tr><td>Maximum safe continuous Temperature</td><td>:</td><td>70 deg C</td></tr><tr><td>Ultimate Elongation</td><td>:</td><td>Not less than 275%</td></tr></table><div>The actual requirements, which will be directed by the Engineer-in-Charge, may vary slightly.</div></div>	Sp. Gr.	:	1.3 to 1.35	Shore Hardness	:	60A to 80A	Tensile Strength	:	>= 120kg/cm ²	Maximum safe continuous Temperature	:	70 deg C	Ultimate Elongation	:	Not less than 275%
Sp. Gr.	:	1.3 to 1.35														
Shore Hardness	:	60A to 80A														
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Maximum safe continuous Temperature	:	70 deg C														
Ultimate Elongation	:	Not less than 275%														
8.01.03	<div>Bitumen Compound</div> <div>When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound shall be laid as per manufacturer's specifications. The compound to be used shall be of approved manufacturer and shall conform to the requirements of IS: 1834 (latest revision).</div>															
8.01.04	<div>Metal Cover Strips</div> <div>Metal cover strips, made from aluminium or mild steel sections shall conform to the relevant IS Codes.</div>															
8.01.05	<div>Acceptance Criteria</div> <div><div>a) All items shall be of correct shape, size, weight, thickness etc. as shown on drawings and schedule of items.</div><div>b) Metal cover, strips when installed, shall be such that permissible deviation from straightness does not exceed 1 in 1000.</div></div>															

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
	<p>c) All sealing strips shall be with minimum possible joints, which shall be watertight and have minimum laps as specified.</p>
8.01.06	<p>IS Codes</p> <p>Following are some of the important IS codes applicable to this Section:</p> <p>IS:1834 : Sealing compounds, hot applied, for joints in concrete</p> <p>IS:1838 : Preformed fillers for expansion joints in concrete, non-extruding and resilient type.</p>
8.02.00	<p>Water Proofing Admixture in Concrete</p> <p>The admixtures proposed to be used by the contractor should conform to IS: 2645 (latest edition). Water proofing additive shall be as far as possible free from aggressive chemicals like Chlorides, Sulphides etc. which can cause corrosion of steel reinforcements in RCC. The Contractor shall have the service of the manufacturer's supervisor at no extra cost to the owner to supervise the work, if desired by the Engineer-in-Charge.</p>
8.02.01	<p>Specification of Waterproofing for Underground Structures:</p> <p>a) Bottom Slab</p> <ol style="list-style-type: none"> 1. Laying of PCC as per drawings and specifications with proper waterproofing compound. Waterproofing compound using 20 to 12 mm stone chips on the lean concrete. 2. Providing and fixing 12mm dia threaded nozzles of suitable length at construction joints and all over the slab in grid pattern with spacing not more than 1.5 M c/c. 3. Providing CICO or equivalent waterproofing compound to be mixed at the time of slab casting as per manufacturer's recommendations. 4. Providing and injecting CICO or equivalent non-shrink waterproof grouting compound mixed with cement in slurry formed by pump through nozzles under pressure as per clause No. 8.02.02. 5. Sealing off the nozzles after injection operation is over. 6. Sikatop Seal 107 painting (2 coats) or equivalent. <p>b) Wall</p> <ol style="list-style-type: none"> 1. Providing CICO or equivalent cement waterproofing compound to be mixed at the time of casting concrete in the vertical wall as per manufacturer's recommendation. 2. Providing and fixing 12mm dia threaded nozzles along the construction joint lines in the wall having penetration upto half the thickness of wall (spacing not more than 1.5 M c/c).

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
	<ol style="list-style-type: none"> 3. Providing and injecting CICO or equivalent non-shrink waterproofing grouting compound to be mixed with cement slurry form by pump through nozzles under pressure as per clause No. 8.02.02 4. Sealing off nozzles after injection operation is over. 5. Application of reinforced plaster (24 GH BGI. Wire netting 25mm mesh) 20mm thick in 1:3 cement mortar with CICO or equivalent cement waterproofing compound and CICO or equivalent plasticizer for external face of wall. <p>c) Construction Joints</p> <ol style="list-style-type: none"> 1. Providing and fixing 12mm dia threaded nozzles of suitable lengths at construction joints and all over the slab in grid pattern with spacing not more than 1.5M c/c. 2. Providing CICO or equivalent waterproofing compound to be mixed at the time of slab casting. 3. Providing and injecting CICO or equivalent non-shrink waterproof grouting compound mixed with cement in slurry form by pump through nozzles under pressures as per clause 8.02.02. 4. Sealing off the nozzles after injection operation is over. 5. Application of reinforced plaster (24 GH BHI wire netting 25 mm mesh) 20 mm thick in 1:3 cement mortar with CICO or equivalent cement waterproofing compound or equivalent plasticizer on the surface.
8.02.02	<p>The procedure for injection method to be followed is as below:</p> <ol style="list-style-type: none"> a) RCC base slab and roof shall be treated by placing threaded nozzles of suitable diameter at 1.5 M c/c grid pattern. Particular care should be taken to place nozzles along the construction joint line, wherever it occurs, at a spacing of 1.5 M. The depth of the nozzles shall be adequate to push the grout at all depth. After curing period is over the threaded nozzles shall be connected to the chemical grout main. The chemical alongwith CICO or equivalent non-shrink waterproofing grouting compound mixed with the neat cement slurry shall then be allowed to flow through the pipes under pressure to fill all possible pores and gaps left within the concrete mass. When the flow of the grout stops, the grout mains shall be disconnected. The pipes then shall be sealed properly to the satisfaction of the Engineer-in-Charge. b) For treatment of wall, the injection method shall be considered with protection from outside. The threaded nozzles of suitable diameter shall be placed in grid pattern and along the construction joint line at a spacing of 1.5 M. The depth of the nozzles shall be less than half the thickness of the vertical wall. The chemical alongwith or equivalent non-shrink waterproofing grouting compound mixed with neat cement slurry shall then be allowed to flow through the pipes to fill the gaps in the concrete. When the flow of the grout stops, the grout main shall be disconnected and the pipes shall be sealed properly to the entire satisfaction of the Engineer-in-Charge.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
8.02.03	<p data-bbox="386 338 626 365">Glass Fibre Tissues</p> <p data-bbox="386 392 1453 552">The work of waterproofing shall be carried out by using Glass Fibre Tissue. The Glass fibre tissue shall be thick, flexible, uniformly bonded mat composed of chemically resistant borosilicate staple glass together with a thermosetting resin and shall conform to IS:7193 (latest revision) and workmanship to IS:3067 (latest revision) and IS:9918 (latest revision).</p> <p data-bbox="386 575 1453 636">Waterproof treatment shall consist of three layers of glass fibre tissue as per details given below:</p> <ol data-bbox="386 657 1453 1186" style="list-style-type: none"> <li data-bbox="386 657 1453 718">a) Clean and prime the surface with bitumen primer @0.4 kg/m³. This should properly embedded the surface and should be left till the time it is touch dry. <li data-bbox="386 741 1027 768">b) Apply first coat of hot bitumen @2.4 kg/m², min. <li data-bbox="386 791 1453 852">c) Apply first layer of glass fibre tissue, overlap shall be 100mm between the layers in either direction. <li data-bbox="386 875 1013 903">d) Apply second coat of hot bitumen @2.4 kg/m². <li data-bbox="386 926 1453 987">e) Apply second layer of glass fibre tissue. This layer of glass fibre tissue shall be embedded perpendicular to the earlier layer. <li data-bbox="386 1010 976 1037">f) Apply third coat of hot bitumen @2.4 kg/m². <li data-bbox="386 1060 1453 1121">g) Apply third layer of glass fibre tissue. This layer of glass fibre tissue shall be embedded perpendicular to the earlier layer. <li data-bbox="386 1144 993 1171">h) Apply fourth coat of hot bitumen @2.4 kg/m². <p data-bbox="386 1203 1453 1528">Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chasis shall be carried out. Protective brickwork, concrete sub-base or walls, cement concrete plaster is to be included in the bid. Half brick masonry shall be of first class brickwork in cement mortar 1:4. A minimum of 12mm thick plaster in 1:4 (1 cement 4 fine sand) below base, above and below damp proofing felt, a minimum of 25mm thick plaster 1:4 (1 cement 4 fine sand) between ½ brick wall and damp proof felt at sides is to be provided. These specifications shall cover laying the damp proof course on the outside of the walls and bases of structures or placed as specified elsewhere. Unless specified otherwise elsewhere 20 years guarantee for perfect performance shall be given the contractor individually and collectively.</p>
8.03.00	<p data-bbox="386 1575 743 1602">Other admixtures in Concrete</p> <p data-bbox="386 1623 1453 1682">The Engineer-in-Charge may at his direction instruct the Contractor to use any admixture in the concrete.</p>

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 09	
9.00.00	CEMENT ADDITIVES / ADMIXTURES IN CONCRETE
9.01.00	SCOPE
	This section of specification deals with the requirements of furnishing, placing and mixing cement additives/admixtures, in all kinds of cement concrete, (plain or reinforced) for all kinds of structures at all levels.
9.02.00	GENERAL REQUIREMENT
9.02.01	The Contractor shall furnish all labour and equipment to place and mix water proofing cement additive and cement plasticizer in concrete of any grade and cement mortar. Thereafter, he shall carry out the work as specified earlier in relevant clauses of this specification for concrete and hence complete the work as indicated on the drawing and as per the specification listed hereunder.
9.02.02	Water proofing additive and other types of admixtures shall be as far as possible, free from aggressive chemical like Chloride, sulphide etc. which can cause corrosion of steel reinforcement in RCC.
9.02.03	The Contractor shall have the services of the manufacturer's supervisor, at no extra cost to the owner, to supervise the work, if directed by the Engineer-in-Charge.
9.02.04	Admixtures in concrete for promoting workability, improving strength, entraining air or for similar purposes may be used only after the written permission from the Engineer-in-Charge, is obtained. Addition of admixtures shall not reduce the specified strength or durability of concrete in any case. The admixtures shall conform to IS: 9103 and shall be of proven make and from a reputed manufacturer. Calcium chloride shall not be permitted to be used other than in mass (plain) concrete works.
9.03.00	MATERIALS
9.03.01	Water proof cement additive shall conform to IS: 2645 and shall be of proven make and from a reputed manufacturer.
9.03.02	Admixtures in concrete shall conform to IS: 9103 and shall be of proven make and from a reputed manufacturer. In addition, for plasticizer-cum-water proofing compound, materials shall meet the permeability requirements as per IS: 2645. Similarly for plasticizer-cum retarder admixture material shall satisfy the setting time requirements of retarder and other properties of plasticizer as per IS: 9103.
9.04.00	MIXING

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9.04.01	Admixtures/water proofing additive shall be used at the rate specified by the manufacturer or as indicated on the drawings and shall be mixed with water, as required by the Engineer-in-Charge.
9.04.02	Samples of concrete in which admixtures and/or water proofing cement additive is added shall be tested for water proof ness, workability, compressive strength, water absorption, density, setting time, etc. The results shall conform to relevant IS specifications.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 10	
10.00.00	GROUTING AND UNDER PINNING
10.01.00	SCOPE
	The specifications cover the furnishing of all labour, materials, and equipment and performance of all operations to complete the work of grouting of block outs and foundation bolt holes and under pinning of base plates.
10.02.00	Materials
10.02.01	Cement shall conform to the stipulations contained in IS: 269 (latest edition).
10.02.02	Sand shall conform to the stipulations contained in IS: 383 (latest edition) and shall have a fineness modules not exceeding 3 and not less than 2.5.
10.02.03	Water shall be clean and fresh and shall be of portable quality.
10.02.04	Aluminium powder or anti-shrinkage admixture like 'Groutex' CRS-NS grout (by Cement Research Institute of India or its equivalent) shall be of standard brand from a reputed manufacturer and shall be approved by the Engineer-in-Charge prior to its use on work.
10.03.00	General Requirements
10.03.01	The block outs and bolt holes which have to be grouted shall be cleaned thoroughly by use of compressed air immediately before taking up the grouting operations.
10.03.02	<p>Grouting</p> <p>Grouting shall be adopted for filling the block outs, pockets and foundations bolt holes. Cement sand mix in 1:1 proportion and aluminium powder or anti-shrinkage admixture of approved quality shall be first blended thoroughly in the required proportion as per manufacturer's specification. Grout shall then be prepared by mixing this admixture with water in the proportion of 2 parts by weight of cement to one part by weight of water. The quantity of aluminium powder shall usually be of the order of 0.005% by weight of cement. Any grout which has been mixed for a period longer than half an hour shall not be used on the work. Immediately after preparation, the grout shall be poured into the block outs, pockets and bolts holes either from the sides or through the holes provided for this purpose in the base plate by using special equipment for pressure grouting. It shall be ensured by rodding and by tapping of bolts that the block out is completely filled without leaving any void. The pouring shall cease as soon as each hole is filled and any excess grout found on the surface on the concrete foundation shall be completely removed and the surface dried.</p>

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS						
10.03.03	<p>Under-Pinning</p> <p>a) It shall be resorted to the filling the space between the underside of base plate and the top of foundation concrete. After grouting has been completed as specified above, space between the top surface of the foundation concrete and the underside of the base plate shall be filled with mortar or concrete depending upon thickness to be filled as follows:-</p> <table><tr><td>Less than 40mm</td><td>Dry packed mortar</td></tr><tr><td>Over 40mm</td><td>Dry packed fine concrete</td></tr></table> <p>Mortar fine concrete shall be blended with aluminium powder (about 0.005% by weight of cement or with anti-shrinkage admixture) in a suitable proportion to the Cement mortar in accordance with the recommendations of the manufacturer and subject to the approval of the Engineer-in-Charge. Mortar shall comprise cement, sand and water in proportion of approximately 1:3:0.4 by weight. In all cases minimum 28 day cube strength should not be less than 25N/sq.mm.</p> <p>Shims provided for the alignment of plant bases shall be positioned at the edges of the bases to permit subsequent removal which shall take place not less than 7 days after the under pinning has been executed. The resulting cavities shall be made good with the same grade of mortar or concrete as has been used for the under pinning of the rest of the base plate.</p> <p>b) Cement, sand and aluminium powder or approved anti-shrinkage admixture, shall first be blended thoroughly in the required proportion. The mortar shall then be prepared by mixing with a quantity of water which will produce a sufficiently workable mix to enable complete and proper compaction of the mortar.</p> <p>c) The mortar shall then be placed below the base plate and rammed in a horizontal direction for each edge until the mortar oozes out through the grout holes provided in the base plate.</p> <p>d) When it is clear that the centre of base has been properly filled the mortar outside the base plate shall be briefly rammed to ensure compaction below the edges.</p> <p>e) Any mortar which has been mixed for a period longer than half an hour shall not be used in the work.</p>	Less than 40mm	Dry packed mortar	Over 40mm	Dry packed fine concrete		
Less than 40mm	Dry packed mortar						
Over 40mm	Dry packed fine concrete						
10.03.04	<p>Curing</p> <p>The work shall be cured for a period of at least 7 days commencing 24 hours after the completion of the grouting and under pinning operations. The curing shall be done by covering the surfaces with wet gunny bags.</p>						
10.03.05	<p>IS Codes</p> <p>Important relevant IS for this clause are:</p> <table><tr><td>IS: 269</td><td>-</td><td>Ordinary and low heat Portland Cement</td></tr><tr><td>IS: 383</td><td>-</td><td>Coarse and fine aggregates from natural sources for concrete.</td></tr></table>	IS: 269	-	Ordinary and low heat Portland Cement	IS: 383	-	Coarse and fine aggregates from natural sources for concrete.
IS: 269	-	Ordinary and low heat Portland Cement					
IS: 383	-	Coarse and fine aggregates from natural sources for concrete.					

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS
SECTION – 11	
11.00.00	ENCASEMENT OF STEEL STRUCTURES / ELEMENTS
11.01.00	SCOPE
	This section of specification deals with the requirement for encasement of steel work in concrete with necessary formwork, placing, finishing and curing, complete as per drawings and specifications.
11.02.00	GENERAL REQUIREMENTS
11.02.01	All concrete work, reinforcement, formwork and staging work shall be done as per stipulations of section 2, 3 and 4 of this specification.
11.02.02	The reinforcement to be provided for encasement of steel elements shall be mild steel bars or in the form of wire netting. Such reinforcement shall be kept 20mm away from the steel member and held securely to it.
11.02.03	The minimum grade of concrete to be used for encasing shall be M-20 unless specified. The aggregate to be used in concrete shall be 12.5 mm maximum size unless specified otherwise. In case of box type steel sections, encasement shall be done with cement sand mortar (1:4) with thickness of 50mm over 0.9 mm size wire netting conforming to IS:3150, or as shown on the drawings.
11.02.04	In the case of encasement of beams with concrete, if the gap between the edge of the shuttering and flange is hardly sufficient for placing the concrete, the workability of the concrete shall be increased suitably by increasing the water cement ratio.
11.02.05	Minimum cover for concrete encasement shall be 50mm.
11.03.00	MATERIALS
11.03.01	The materials shall be in accordance with the relevant clauses of Technical Specification for Properties, Storage and handling of common Building Materials which shall be deemed to form the part of this specification. Hexagonal wire netting shall be 0.9mm dia and 19mm aperture size, conforming to IS: 3150.

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Clause No.

CAST IN SITU CONCRETE AND ALLIED WORKS

TABLE – 4
FREQUENCY OF SAMPLING AND TESTING

Sl. No.	Nature of Test/ Characteristics	Method of Test	No. of samples and Frequency of Test	Remarks
1.	Coarse Aggregates			
a)	Particle size and shape	IS:2386 (Pt.1)	One per 100 cu.m. or part thereof or change of source whichever is earlier.	Result to be as per the requirement of design mix, subject to variations within the lists specified in relevant Indian Standard.
b)	Moisture Content	IS:2386 (Pt.III)	Once for each stack of 100 cu.m. or part thereof except during monsoon when this has to be done every day before starting of the work.	Accordingly water content of the concrete shall be adjusted.
c)	Specific gravity, density, voids, absorption	IS:2386 (Pt.III)	Once in 12 weeks or change of source, whichever is earlier.	These tests shall be carried out while establishing design mix and results to be intimated.
d)	Mechanical properties, crushing value, abrasion value, abrasion value and impact value.	IS:2386 (Pt.IV)	Once per source	Acceptance works shall be as per IS:383.
e)	Soundness	IS:2386 (Pt.V)	Once per source	Acceptance norms shall be as per IS:383.
f)	Reaction with alkali	IS:2386 (Pt.VII)	Once per source	These tests shall be carried out while establishing design and result to be intimated. Acceptance shall be as per IS:2386 (Pt.7)
g)	Flakiness and petro-graphic examinations	IS:2386	This is to be done once and should be repeated in case the source is changed.	These tests shall be carried out while establishing design mix and results to be intimated.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS			
	h) Deleterious materials	IS:2386 (Pt.II)	Once per source	Results should be within the list as specified in relevant Indian Standard and in this Specification.
2.	Fine Aggregates/Sand			
	a) Particle size and shape	IS:2386 (Pt.1)	One per 100 cu.m. or part thereof or change of source, whichever is earlier.	Should be as per the requirement of design mix, subject to variation within the list as specified in relevant IS Codes.
	b) Specific gravity, density voids, absorption and bulking.	IS:2386 (Pt.III)	Once in 12 weeks or change of source whichever is earlier.	These tests will be carried out while establishing design mix and results to be intimated.
	c) Bulkage, moisture content (Routine test)	IS:2386 (Pt.III)	To be done everyday before start of work.	Volume of sand and weight of water as per bulkage and moisture content.
	d) Silt, clay deleterious materials, organic impurities.	IS:2386 (Pt.II)	Once per source and to be repeated, if source is changed.	Acceptance norms shall be as per IS:383.
	e) Soundness and Petrographic examination.	IS:2386 (Pt.VI & VIII)	Once per source	Acceptance norms shall be as per IS:383.
	f) Mortar making properties	IS:2386 (Pt.VI)	Once per source	Acceptance norms shall be as per IS:383.
	g) Reaction with alkali.	IS:2386 (Pt.VII)	Once per source	Acceptance norms shall be as per IS:383 and IS:2386 (Pt.7)
3.	Cement			
	a) Setting time	IS:4031	One sample of each received from stores.	Acceptance norms shall be as per relevant Indian Standard.
	b) Compressive strength	IS:4031	One sample of each received from stores.	Acceptance norms shall be as per relevant Indian Standard.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS			
4.	Water			
	Harmful substances, pH value, initial setting time, compressive strength.	IS:3025, IS:4031 & IS:516	Once a month for each source.	Acceptance norms shall be as per Cl. 4.3 of IS:456-1978.
5.	Concrete			
a)	Workability (Slump and compaction factor).	IS:1199	One sample every two hours from every mixing plant.	Acceptance value shall be as per Cl. 6.1 of IS:456-1978.
b)	Crushing Strength	IS:516	i) As per Cl. 14.2.2 of IS:456-1978 for initial period. ii) One sample of six cubes per 150 cu.m. or part thereof for mass concrete for subsequent period.	Acceptance criteria shall be as per CL. 15 of IS:456-1978. A minimum of 3 specimens shall be tested for 28 days strength.
c)	Water-cement ratio.	IS:1199	At random at the time of batching.	According to mix design.
d)	Cement Content	IS:1199	At random at the time of batching.	According to mix design.
e)	Water tightness test (for water retaining structures).	IS:3370	Each tank or reservoir.	Acceptance criteria as per specification.
f)	Finished dimensions	Physical measurement	All structures	Acceptance as per specification.
6.	Form work			
a)	Staging (Durability, strength & soundness of staging, joints, adequacy of its foundation and specific level).	Visual	Each Member	Any staging intended for use shall be approved by the Engineer-in-Charge for its durability and strength. After erection of staging, nominated representatives of Engineer-in-Charge shall check the soundness of the staging as a whole, its joints, adequacy of its foundation and the specific levels.

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Clause No.	CAST IN SITU CONCRETE AND ALLIED WORKS			
	b) Shuttering			
	i) Materials	Visual	Random	
	ii) Joints	Visual	Random	
	iii) Dimensions & Plumb	Physical measurement	Each member and before every lift.	Joints shall be leak-proof to avoid loss of liquid.
7. Reinforcement				
	a) Placement	Visual	Each	Tolerance as per Specifications. The bar bending schedule with the necessary hooks, laps, cover, spacers and chairs shall be 100% checked for all concreting works before start of the work.
	b) Cutting tolerance	Physical measurement	Random	Tolerance shall be as per specification.
	c) Freedom from defects.	Visual	Random	Any of the bars selected for use shall be free from traces, surface flaws, laminations and rough, jagged and imperfect edges.
8. Embedded Parts				
	a) Type of embedment	Visual	Each Part	Type/Details shall be as per drawings. Tolerance as per specification.
	b) Location	Physical	Each Part	Detail as per drawings. Tolerance as per specification.

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Clause No.	PRECAST CONCRETE WORKS
1.00.00	SCOPE
1.01.00	This section of the specification deals with the manufacturing and erection of plain or reinforced pre-cast concrete members.
1.02.00	Type of pre-cast members shall be in the form of trench/floor opening cover, fin, fascia, coping, lintel, chajja, wall panel, beam, column and roof unit. Pre stressed pre-cast members have not been covered under this specification.
2.00.00	GENERAL REQUIREMENTS
2.01.00	The technical specification for cement concrete, formwork, and reinforcement covered under Technical Specification for Cast-in-Situ Concrete and Allied Works shall be deemed to form a part of this Specification.
2.02.00	This section covers furnishing of all labour, materials and equipment, and performing all operations required for the manufacturer and transportation of pre-cast concrete items, hoisting and fixing them in position to correct lines and levels, filling joints and other wise finishing, cutting of the lifting hooks etc. complete and testing of pre-cast members. Structural steel or other embedment, if any, indicated on the working drawings shall also be embedded in pre-cast members.
2.03.00	The pre-cast members shall be manufactured in a yard at the project site. This yard shall have hard and levelled platform, and shall preferably be fenced. The Contractor shall arrange for all the necessary facilities like shed, casting bed, curing tank, handling equipment and transportation, etc. complete.
2.04.00	The grade of the concrete and the type of pre-cast element to be used shall be as called for in the schedule of items or as shown on the drawings. Unless otherwise specified, minimum M20 grade of concrete shall be used.
2.05.00	The Contractor shall provide a complete scheme of casting of pre-cast concrete units with erection programme for the approval of the Engineer-in-Charge. However, this approval shall not relieve the Contractor of his responsibility for safe and sound work.
3.00.00	CODES AND STANDARDS
3.01.00	In addition to the relevant Indian Standards and codes as mentioned under Standard Technical Specification for Concrete and Allied Works, following additional applicable Indian Standards, Codes etc. are referred to here below. In case of discrepancy between this specification and those referred to herein, the stringent of the two shall govern. A copy of all these documents shall generally be available at site, with the Contractor :
	SP: 7 (PART VI/Sect. 7) : National Building Code-Structural design of prefabrication and system building.

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Clause No.	PRECAST CONCRETE WORKS
IS: 3201	: Criteria for Design and Construction of Pre-cast Concrete Trusses.
IS: 10297	: Code of practice for design and construction of floors and roofs using pre-cast rein forced/pre-stressed concrete ribbed or cored slab units.
IS: 10505	: Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.
IS: 11447	: Code of practice for construction with large panel prefabricates.
4.00.00 CONCRETE MIX	
4.01.00	The concrete mix for various type of pre-cast units, shall conform to IS:456. The grade of concrete for different pieces of construction shall be as specified or shown on drawings.
4.02.00	Aggregates shall be mixed by weight and the water cement-ratio shall be controlled so as to obtain a dense concrete of the required strength. The size of aggregate shall not be more than 20mm. However for narrow and thinner sections like roof units, 12.5mm size down graded material shall be used.
5.00.00 FORMWORK	
5.01.00	The form work for the pre-cast members shall be made up of steel, plywood or wood lined with galvanised M.S. sheet so as to obtain a smooth surface after the forms are struck. The Contractor shall submit detailed drawings of formwork for approval. Vibration shall be carried out to obtain a good finish. In addition, rodding shall be done to ensure that the concrete material is evenly spread and fills all inaccessible regions. Top exposed surface shall be finished smooth with cement mortar (1:3), wherever required.
6.00.00 REINFORCEMENT	
6.01.00	The reinforcement shall conform to IS: 432 (Part-I), IS: 1786 or IS: 1566 as specified on the drawings. Bending, binding and placement of reinforcement shall be as per IS: 2502 and Section-4 of Module-4.
7.00.00 FIXING OF STRUCTURAL STEEL EMBEDEMETS	
7.01.00	Structural steel is the form of angles, flats, etc. which shall be either issued by the Engineer-in-Charge within the project area or supplied and fabricated by the Contractor shall be transported and embedded in position in various pre-cast members to correct lines and levels by means of welding or otherwise as indicated on the details working drawings.

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Clause No.	PRECAST CONCRETE WORKS
8.00.00	HANDLING
8.01.00	Each pre-cast member shall be suitably marked to indicate the top of the member and its location and orientation in the structure and date of casting in order to facilitate in distinguishing the dates of casting of various members. The Contractor shall also maintain a register indicating the date of casting of various members, curing, transportation and erection. To ensure minimum damage during handling, the Contractor shall provide suitable cranes capable of lifting the heavy pieces on to the places of erection. The responsibility for any damage for whatsoever reasons it may be, shall be that of the Contractor and he shall replace the damaged pieces.
9.00.00	CURING
9.01.00	Either natural curing with water or an accelerated curing using steam shall be followed. Water curing shall be carried out for a period of seven days from the day of casting. This shall be done by providing a water tank of adequate size nearby wherein the pre-cast members shall be immersed.
10.00.00	ERECTION
10.01.00	The erection shall be done as indicated on the working drawings. The Contractor shall provide a scheme and erection drawings for the approval of the Engineer-in-Charge before commencement of erection.
10.02.00	The pre-cast roof units/slabs shall generally rest on the steel structure. The pre-cast elements shall be secured in position as shown on the drawings.
10.03.00	The pre-cast units shall be welded in position to the structural steel by means of matching pieces already embedded in pre-cast elements.
10.04.00	After the erection of the pre-cast elements at site, the hooks provided for lifting purpose shall be cut flush to the surface of the slab as and when desired by the Engineer-in-Charge.
10.05.00	While erecting the pre-cast elements all necessary safety precautions for the safety of equipment and structures and personnel located/working in the area shall be taken. The equipment used for lifting and erecting the pre-cast elements are lifted to position without swings or jerks. While welding the pre-cast elements to the trusses and other steel structures, special care shall be taken to see that sparks resulting from welding shall not cause any fire hazards. Other necessary precautions shall also be taken to see that no damage is caused to equipment or personnel, located in the area.
11.00.00	SAMPLING, TESTING AND QUALITY ASSURANCE
11.01.00	All the relevant clauses pertaining to technical specifications for concrete and Allied

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Clause No.	PRECAST CONCRETE WORKS
	works shall be applicable. This shall include testing for concrete mix.
11.02.00	Load tests shall also be carried out for the type of members as decided by the Engineer-in-Charge as per the provisions made under IS: 456.
11.03.00	<p>Tolerance on dimensions</p> <p>Tolerance on dimensions of pre-cast, units shall be as follows;</p> <ul style="list-style-type: none">a) Length: +/- 0.1 percent subject to minimum of +/- 5mm and maximum of +10 mm.b) Cross-sectional dimensions: +/-3mm or +/-0.1 per cent whichever is greater.c) Straightness of Bow: 1/750 of the length subject to minimum of +/- 5mm and maximum of +/- 10mm.d) Squareness: When considering the square ness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5mm.e) Flatness: The maximum deviation from a 1.5m straight edge placed in any position on a nominal plane surface shall not exceed 5mm.

MODULE - C6

Clause No.	TECHNICAL SPECIFICATION FOR COMMON CIVIL WORKS
SECTION – 01: MASONRY AND ALLIED WORKS	
1.00.00	MASONRY AND ALLIED WORKS
1.01.00	Scope
	This section of the specification covers, furnishing installation including handling, transporting, batching, mixing, laying, scaffolding, centering, shuttering, finishing, curing, protection and repairing till handing over of brick masonry, stone masonry and allied works including DPC, plinth protection etc.
1.02.00	General Requirements
1.02.01	The Contractor shall furnish all skilled and unskilled labour, plant, equipment, scaffolding, materials, etc. required for complete execution of the work in accordance with the drawings and as described herein and/or as directed by the Engineer-in-Charge.
1.02.02	All workmanship shall be in accordance with the latest standards and best possible practice. Masonry work shall be true to line and level as shown on drawings. All such masonry shall be tightly built against structural members and bonded with dowels, anchors, inserts, etc. as shown on drawings.
1.02.03	The Contractor shall carry out all works for setting out the building lines, locating the co-ordinates and establishing the reduced levels (RL's) on the basis of reference grid lines and bench mark, which shall be furnished by the Owner, at one or more locations.
1.02.04	Any approval, instructions, permission, checking, review, etc. whatsoever by the Engineer-in-Charge shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship, etc.
1.03.00	Codes and Standards
1.03.01	All applicable standards, acts and codes of practice referred to shall be the latest editions including all applicable official amendments and revisions. A complete set of all these documents shall generally be available at site, with the Contractor.
1.03.02	In case of conflict between this specification and those (IS Standards, Codes etc.) referred to in clause 1.3.3, the more stringent of the two shall prevail.
1.03.03	Some of the applicable India Standards, Codes, etc. are referred to here below :
	IS:1127 : Recommendations for Dimensions and Workmanship of Natural Building Stones for Masonry work.

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Clause No.	TECHNICAL SPECIFICATION FOR COMMON CIVIL WORKS
	<p>IS:1200 : Method of measurement of building and civil engineering works. Part-3 Brick Work Part-4 Stone masonry</p> <p>IS:1597 : Code of practice for construction of Stone Masonry</p> <p>IS:1905 : Code of Practice for Structural Safety of Buildings – Masonry walls.</p> <p>IS:2116 : Specification for sand for masonry mortars.</p> <p>IS:2212 : Code of Practice for Brickwork.</p> <p>IS:2250 : Code of Practice for Preparation and Use of Masonry Mortar.</p> <p>IS:3414 : Design and installation of joints in buildings.</p> <p>IS:3696 : Safety code for scaffolds and ladders.</p> <p>IS:4130 : Safety code during demolition of buildings.</p> <p>IS:4326 : Code of practice for earthquake resistant design and construction of buildings.</p> <p>SP:20 : Explanatory hand book on masonry code.</p>
1.04.00	Brick Masonry
1.04.01	<p>Materials</p> <p>Properties of common building materials for the construction of brick masonry, viz., burnt clay bricks, sand, lime and cement shall be in accordance with the standard technical specification for 'Properties, Storage and Handling of Common Building Materials'. Besides clay bricks, other type of bricks like, fly ash-lime bricks cured by autoclave process shall also be used, whenever specified, or shown on the drawing.</p>
1.04.02	<p>Mortar</p> <p>IS: 2250 shall be followed as general guidance for preparation and use of mortar. Only cement-sand mortar shall be used. Lime shall be added for composite mortar with specific approval of the Engineer-in-Charge.</p> <p>Unless otherwise specified, mortar for brickwork having one or more brick thickness shall be 1 part cement and 6 parts sand by volume. Mortar for half-brick thick walls</p>

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shall be 1 part cement and 4 parts sand by volume. Richer mix proportion shall be used, whenever specified or as per design requirement. Mortar shall meet the compressive strength requirement as per IS: 2250 and IS: 1905.

Sand shall conform to IS: 216. Grading of sand when tested as per IS: 2386 shall be as specified in Table-1.

TABLE – 1

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS Sieve designation IS:460 (Part-I)	Method of Test	Percentage of passing by mass
4.75 mm	IS : 2386 (Part-I)	100
2.36 mm		90 to 100
1.18 mm		70 to 100
600 micron		0 to 100
300 micron		5 to 70
150 micron		0 to 15

Sand, whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, may be processed to comply with the standard by screening through a suitably sized sieve of sand particles. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand given in Table-1 may be considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed, shall be uniformly distributed throughout the mass. The required grading may often be obtained by screening and/or by blending together either natural sands or crushed stone screenings, which are by themselves of unsuitable grading.

Cement and sand shall be thoroughly mixed dry in a mechanical mixer and water shall then be added to obtain a mortar of the consistency of a stiff paste, care being taken to add just sufficient water for the purpose. Water shall be clean and free from injurious amount of deleterious matter such as oil, acid, alkali, salt and vegetable growth. Hand mixing may be allowed by the Engineer-in-Charge on clean approved platform in special cases only. Mortar shall be used as early as possible after mixing, before it begins to set and preferably within 30 minutes after water is added to the dry mixture. Mortar unused for more than 30 minutes shall generally be rejected and removed from site of work. However, the Engineer-in-Charge may allow the use of mortar upto 2 hours.

Surplus mortar droppings while laying masonry, if received on a surface free from dirt, maybe mixed with fresh mortar if permitted by the Engineer-in-Charge, who may direct for addition of extra cement and this shall be implemented.

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Clause No.	TECHNICAL SPECIFICATION FOR COMMON CIVIL WORKS
1.04.03	<p>Laying</p> <p>IS: 2212 shall be followed as general guidance for construction of brick masonry. Vat/tank of suitable size shall be provided by the Contractor for soaking of the bricks. Brick shall be soaked in water before use for a period generally not less than 6 hours so that the water just penetrates the whole depth of the bricks. Bricks shall be laid in by hand and not thrown inside the tank. Bricks shall be taken out sufficiently in advance so that these are skin dry at the time of laying.</p> <p>Brick shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except where necessary to complete the bond. Closers in such cases shall be cut to the required size and used near the ends of the walls, next to quoin headers.</p> <p>Bricks shall be laid generally with frogs upwards. A layer of mortar shall be spread on the full width and over a suitable length of the lower course. Each brick shall be properly bedded and set home (in position) by gently tapping with the trowel handle or with a wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of a course, all vertical joints shall be fully filled from the top with mortar. The thickness of joints shall be kept uniform and shall not exceed 10mm. Bricks shall be so laid that all joints are full of mortar.</p> <p>All face joints shall be raked to a minimum depth of 15mm by raking tools during the progress of brickwork, when the mortar is still green, so as to provide proper key for the plaster or pointing to be done. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying.</p> <p>Brickwork in walls shall be taken up truly plumb. All courses shall normally be laid truly horizontal unless indicated to be laid on slope and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. Brick wall shall be constructed with atleast one plain face with proper alignment.</p> <p>All connected brickwork shall be carried up simultaneously and no portion of work shall be left more than one metre below the rest of the work. Where this is not possible, in the opinion of the Engineer-in-Charge, the works shall be raked back according to bond (and not toothed) at an angle not steeper than 45 degrees. The work done per day should not be more than one metre height.</p> <p>All iron fixtures, pipes, water outlets, holdfasts for doors and windows, etc. which are required to be built into the brickwork shall be embedded in their correct position in mortar or cement concrete as the work proceeds as per directions of the Engineer-in-Charge.</p> <p>All brickwork shall be built tightly against columns, floor slabs or other structural parts and around door and window frames with proper distance to permit caulked joint. Where drawings indicate that structural steel columns and spandrel beams are to be partly or wholly covered with brickwork, the brick shall be laid closely against all flanges and webs with all spaces between the steel and brickwork filled solid with mortar not less than 10mm in thickness.</p> <p>The top courses of all plinth, parapet, steps and top wall below R.C.C. shall be laid with brick on edge (other than modular size bricks) unless otherwise specified. Care shall be taken that the bricks forming the top courses and ends of walls are properly radiated</p>

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	<p>and keyed into position as shown on the drawings.</p> <p>Scaffolding shall be strong enough to withstand all the dead, live and impact loads which are likely to come upon it. It shall also be so designed as to ensure the safety of the workmen using them.</p> <p>For all brick masonry except for exposed brickwork, single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.</p> <p>In case of joining old brickwork with new brick work, the old work shall be toothed to the full width of the new wall and to the depth of quarter of a brick in alternate courses. It shall be cleaned of all dust, loose mortar, etc. and thoroughly wetted before starting new brick work. Thickness of each course of new work shall be made equal to the thickness of the corresponding course of the old work by adjusting thickness of horizontal mortar joints.</p> <p>The face of the brickwork shall be cleaned on the same day on which brickwork is laid and all mortar droppings removed promptly.</p> <p>Template (bed block) of plain or reinforced cement concrete shall generally be provided to support ends of RCC beams. Top surface of the wall shall be suitably treated as per direction of the Engineer-in-Charge so as to minimise the friction to movement of the concrete slab over the bearing.</p> <p>Brickwork shall be protected from rain by suitably covering when the mortar is green. Masonry work shall be cured by keeping it constantly moist on the faces for a minimum period of seven days. Brickwork carried out during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.</p>
1.04.04	<p>Half brick masonry</p> <p>The work shall be done in the same manner, as mentioned in 1.4.3 except that all course shall be laid with stretchers. In case where reinforcement is considered necessary from structural consideration, 2 nos. 8mm dia bars shall be provided generally at every fourth course or as specified on the drawings. Before laying reinforcement, it shall be securely anchored at their ends where the partition ends. Half the mortar thickness for the bedding joint shall be laid first and then two 8mm dia bars laid straight out near each face of the brickwork maintaining a side cover of 12mm mortar. Subsequently the other half of the mortar thickness shall be laid covering the reinforcement fully.</p>
1.04.05	<p>Exposed brickwork</p> <p>Exposed brickwork i.e. brickwork in superstructure which is not covered by plaster shall be as shown on the drawings and shall be done especially by skilled masons. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. Thickness of brick courses shall be kept uniform and for this purpose wooden straight edge with</p>

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Clause No.	TECHNICAL SPECIFICATION FOR COMMON CIVIL WORKS
	<p>graduations indicating thickness of each course including joint shall be used. The height of window sills, bottom of lintels and other such important points in the height of the wall shall be marked on the graduated straight edge. Masons must check workmanship frequently with plumb, spirit level, rule and string.</p> <p>For all exposed brick work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.</p> <p>If face bricks are specified on the drawings, the brickwork shall be in composite work with face bricks on the exposed face and balance in standard bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from available stack of bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used, carborundum stone shall be used for rubbing down.</p>
1.04.06	<p>Reinforcing Anchorage</p> <p>For external walls, the anchorage in the form of flats or rods from spandrel beams and columns and any other anchoring and reinforcement as shown on the drawing shall be adequately embedded in the masonry.</p>
1.05.00	Stone Masonry
1.05.01	<p>Rubble stone masonry which is commonly used in stone work has been covered under this specification. Details of construction for Random Stone Masonry (uncoursed) and Coursed Rubble Masonry (first and second sorts) are given in the following clauses. IS: 1597 shall be followed as general guidance for construction of stone masonry.</p>
1.05.02	<p>Stone</p> <p>The stone shall be of the type specified, such as granite, sand stone, quartzite, and/or best locally available stone which shall be subject to approval of the Engineer-in-Charge. It shall be obtained only from an approved quarry. Colour of the stone shall be as shown on the drawings or approved by the Engineer-in-Charge. It shall be hard, sound, durable and free from decay, weathering. It shall also be free from defects like cavities, cracks, sand holes, flaws, veins, patches of soft or loose materials, etc. Stones with round surface shall not be more than 5 percent when tested in accordance with IS: 1124. The minimum crushing strength of stone shall be 200kg/sq.cm unless otherwise specified.</p>
1.05.03	<p>Size of Stone</p> <p>Normally, stones used should be small enough to be lifted and placed by hand. The length of stone, shall not exceed three times the height and the breadth on base shall not be greater than three-fourth of the thickness of wall, not less than 15 cm. The height of stone may be upto 30 cm.</p>
1.05.04	<p>Mortar</p> <p>Unless otherwise specified, mortar for stone masonry shall be 1 part cement and 6</p>

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	<p>with handle of trowel or wooden mallet. Its inside face shall be applied with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.</p> <p>The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.</p> <p>Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.</p>
1.08.00	<p>Damp Proof Course (DPC)</p> <p>All walls in a building shall be provided with a damp proof course generally immediately below the underside of the ground floor or as shown on the drawings. This shall run without break throughout the length of the wall, even under door or other openings.</p> <p>Damp proof course shall be 50mm thick (unless, otherwise specified) consisting of cement concrete in proportion 1:1.5:3, (1 cement: 1.5 sand: 3 graded stone aggregate of 10mm nominal size) mixed with water proofing cement additive as approved by the Engineer-in-Charge. The additive shall be used in proportion recommended by the manufacturer.</p> <p>The surface of masonry work shall be levelled and prepared before laying the cement concrete; Edges of DPC shall be straight and even. The side shuttering shall consist of wooden forms and shall be strong and properly fixed so that it does not get disturbed during compaction and mortar does not leak through. The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass. When the side shuttering is removed, the surface should be smooth without any honeycombing. The top surface shall be double chequered and cured by ponding for at least 7 days. The cement concrete shall be allowed to dry for at least 24 hours after curing and hot bitumen of grade 85/25 conforming to IS:702 at the rate of 1.7kg/sq.metre shall be applied over the dried up surface of cement concrete after being properly cleaned with brushes and finally with a cloth soaked in kerosene oil. The bitumen shall be applied uniformly so that no blank spaces are left anywhere.</p>
1.09.00	<p>Sampling Testing and Quality Control</p>
1.09.01	<p>General</p> <p>a) The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and/or International Standards and shall conduct such tests as are called for by the Engineer-in-Charge. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer-in-Charge. Tests shall be done in the field and at a laboratory approved by the Engineer-in-Charge and the Contractor shall submit to the Engineer-in-Charge, the test results in triplicate within three days after completion of a test. The Engineer-in-Charge may, at his discretion, waive off some of the stipulations</p>

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	<p>given below, for small and unimportant operations.</p> <p>b) Material/work found unsuitable for acceptance, shall be removed and replaced by the Contractor. The works shall be redone as per specification requirements and to the satisfaction of the Engineer-in-Charge.</p>
1.09.02	<p>Quality Assurance Programme</p> <p>The Contractor shall submit and finalise a detailed field Quality Assurance Programme within 30 days from the date of award of the Contract according to the requirements of the specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/ experienced manpower, preparation of format for record, field quality plan etc. On finalised field quality plan, the Owner shall identify, customer hold points beyond which work shall not proceed without written approval from the Engineer-in-Charge.</p>
1.09.03	<p>Frequency of sampling and testing including the methods for conducting the tests are given in Table-2. The testing shall be done at site. The testing frequencies set forth are the desirable minimum and the Engineer-in-Charge shall have the full authority to carry out or call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. Some of the type of tests and performance tests which are not included in the table shall be carried out at the manufacturer's premises or at an independent Government approved laboratory.</p> <p>a) Deviation in verticality in total height of any wall of a building more than one storey in height shall not exceed $\pm 12.5\text{mm}$.</p> <p>b) Deviation from vertical within a storey shall not exceed $\pm 6\text{mm}$ per 3m height.</p> <p>c) Deviation from the position shown on the plan of any brickwork more than one storey in height shall not exceed 12.5mm.</p> <p>d) Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment shall not exceed 6mm.</p> <p>e) Deviation of bed joint from horizontal in any length upto 12m shall not exceed 6mm, and in any length over 12m it shall not exceed 12.5mm total.</p> <p>f) Deviation from the specified thickness of bed-joints, cross-joints or perpend shall not exceed $\pm 3\text{mm}$.</p>

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Clause No.	TECHNICAL SPECIFICATION FOR PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE				
SECTION – 02: PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE					
2.00.00	PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE				
2.01.00	<p>Scope</p> <p>This specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of plastering and allied finishes to masonry and concrete. This shall also include the work to be done to make surfaces suitable for receiving the finishing treatment and any further finishing treatment over base finishing treatment.</p> <p>Before commencing work on the finishing items the Contractor shall obtain the approval of the Engineer-in-Charge regarding the scheduling of work to minimise damage by other contractors. He shall also undertake normal precautions to prevent damage or disfiguration to work of other contractors and other installations.</p>				
2.01.01	<p>Preparation of Surface</p> <p>All joints in masonry walls shall be raked out to a depth of at least 10mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brushes to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered.</p> <p>For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.</p> <p>At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to boring the base to the required level shall be brought to the notice of the Engineer-in-Charge and his approval shall be taken regarding the method and extent of rectification work required.</p> <p>Prior to commencement of actual finishing work, the approval of the Engineer-in-Charge shall be taken as to the acceptability of the base.</p>				
2.01.02	<p>Mix</p> <p>Mortar for plastering in the proportion as specified on Drawings/specification, shall be mixed in a dry state and then wetted and mixed thoroughly to obtain the required consistency. The mortar shall be mixed in an approved manner including machine mixing if desired by the Engineer-in-Charge and in batches so that the mortar is consumed within half an hour of mixing. Mortar for plaster which is partially set shall be rejected and removed from site.</p> <p>The mix for plastering shall be as follows:</p> <p>230 m thick brick wall</p> <table data-bbox="381 1858 1185 1942"> <tr> <td>Outside plaster</td><td>- 18 mm thick – 1:4 (1 cement :4 fine sand)</td></tr> <tr> <td>Inside plaster</td><td>- 12 mm thick – 1:6 (1 cement : 6 fine sand)</td></tr> </table>	Outside plaster	- 18 mm thick – 1:4 (1 cement :4 fine sand)	Inside plaster	- 12 mm thick – 1:6 (1 cement : 6 fine sand)
Outside plaster	- 18 mm thick – 1:4 (1 cement :4 fine sand)				
Inside plaster	- 12 mm thick – 1:6 (1 cement : 6 fine sand)				

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Clause No.	TECHNICAL SPECIFICATION FOR PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE
	<p>115 m thick brick wall (to be used only for inside walls)</p> <p>Plaster - 12 mm thick - 1:4 (1 cement, 4 fine sand)</p> <p>Concrete ceiling</p> <p>Plaster - 6mm thick - 1:4 (1 cement, 4 fine sand)</p>
2.01.03	<p>Wall Plaster</p> <p>a) Internal Wall Plaster :</p> <p>The internal wall plaster shall be laid in a single coat of 12 mm thickness. The mortar shall be dashed on the prepared surface with a trowel and finished smooth by trowelling on the surface. The standard of finish expected is high and shall conform to IS: 2394. Internal wall plaster shall be carried out on jambs, lintel and sill faces, top and undersides, etc. as shown in the drawing or as directed by Engineer-in-Charge. Wall plaster shall commence at top and work downwards.</p> <p>b) External Wall Plaster :</p> <p>External wall plaster work shall be carried out in 2 layers, the first layer being 12mm thick and 2nd layer being 6mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise directed by the Engineer-in-Charge.</p>
2.01.04	<p>Ceiling Plaster</p> <p>Ceiling plaster shall be done in the areas shown in drawings and wherever required by Engineer-in-Charge, in a manner similar to internal wall plaster and applied before wall plaster. The thickness of mortar and its grade shall be as specified elsewhere.</p>
2.01.05	Nil
2.01.06	<p>Chicken wire mesh in plaster</p> <p>Where specified in drawings, chicken wire mesh of 18 gauge shall be provided in junctions between masonry, RCC work etc. with minimum width of mesh of 150 mm along the length of the junctions a butting minimum 75 mm onto masonry, RCC surface etc. and fixed in position with suitable M.S. nails spaced at not greater than 150 mm/cc, and then plaster as specified applied over the mesh works as directed by Engineer-in-Charge.</p> <p>Drip courses as indicated in drawings shall be provided at the time of plastering.</p>
2.01.07	<p>Lath Plaster</p> <p>Lath plaster is to be provided as shown on drawing or as directed by the Engineer-in-Charge.</p>
2.01.08	<p>Grooves in Plaster</p> <p>Where specified in drawings rectangular grooves as per drawings shall be provided in external plaster by means of timber battons fixed on plaster when plaster corners is still</p>

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Clause No.	TECHNICAL SPECIFICATION FOR PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE
	<p>in green condition. Battons shall be carefully removed after initial set of plaster and broken edges and corners made good. All grooves shall be uniform in width and depth and shall be truly plumb and correctly aligned.</p>
2.01.09	<p>Lime Punning (Neeru Finish)</p> <p>For plastered surface, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, sieved and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall not be less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workmen and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer-in-Charge.</p>
2.01.10	<p>Plaster of Paris Punning</p> <p>Plaster surfaces where specified shall be finished with Plaster of Paris punning. The material shall be approved by the Engineer-in-Charge. Thickness of punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.</p>
2.02.00	<p>Application of Plaster</p> <p>Plaster when more than 12mm thick, shall be applied in two coats, a base coat followed by finishing coat. The thickness of base coat shall however, shall not exceed 12mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coat shall not be less than the minimum thickness shown on drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than applied by trowel.</p> <p>To ensure even thickness and true surface, patches or plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster. All vertical edges of brick pillars, door jambs etc. shall be chamfered or rounded off as directed by the Engineer-in-Charge. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer-in-Charge shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.</p> <p>Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. The decision as to when the plaster has hardened will be given by the Engineer-in-Charge. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days. Whenever the specification calls for water proofing, the CONTRACTOR shall provide the percentage of water proofing compound as specified.</p>

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Clause No.	TECHNICAL SPECIFICATION FOR PLASTERING AND ALLIED FINISHES TO MASONRY AND CONCRETE
2.03.00	<p>Water Proofing Admixtures</p> <p>If directed by the Engineer-in-Charge, the contractor shall use approved water proofing admixtures made by reputed manufacturer in the mortar for plaster work. The quantity to be used etc. shall be in accordance with the manufacturer's instructions subjected however to the approval of the Engineer-in-Charge. These admixtures shall not contain calcium unless specifically allowed by Engineer-in-Charge and shall conform to IS:2645.</p>
2.04.00	<p>Finish</p> <p>Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer-in-Charge. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer-in-Charge regarding the texture, colour and finish.</p>
2.05.00	<p>Standard Finish</p> <p>Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.</p>
2.06.00	<p>Neat Cement Finish</p> <p>Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per sq.m. and rubbed smooth with a trowel.</p>
2.07.00	<p>Rough Cast Finish</p> <p>A wet plastic mix of 3 parts coloured cement, 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm, as approved by the Engineer-in-Charge) shall be thrown on to the wall by means of plaster's trowel and left in the rough condition. The mix shall again be dashed over the vacant spaces, if any, so that the surface represents homogeneous surface of sand mixed with gravel.</p>
2.08.00	<p>Pointing</p> <p>Pointing shall be of the type such as 'ruled', 'cut' or 'weather struck' etc. as indicated in the drawing. Following general specifications shall apply to all types of pointing. All joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall not be less than 12 mm. Mortar specified mix only shall be used. The mortar shall be pressed into the raked out joints with a pointing trowel either flush, sunk or raised according to the type of pointing required. The mortar shall not spread over the corners, edges, surfaces of masonry. The pointing shall then be finished with the proper tool as required for the particular kind of pointing specified. The superfluous mortar shall then be cut off from the edges of the lines and the surface mortar shall then be cut off from the edges of the lines and the surface finish shall be such that the pointing is to the exact size and shape as stipulated.</p>
2.09.00	<p>Acceptance Criteria</p>

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	<p>Finish to masonry and concrete shall fully comply with the drawings, specifications, approved samples and instructions of the Engineer-in-Charge with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawing.</p>
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Clause No.	CONSTRUCTION OF ROADS & HARD STANDINGS / PAVING
SECTION – 09	
9.00.00	CONSTRUCTION OF ROADS AND HARD STANDINGS
9.01.00	General
	The specifications shall apply to all roadwork as well as hard standings required to be designed and constructed under the contract. Work shall be carried out as per relevant codes of Indian Road Congress (IRC)
9.01.01	The Geometric design of roads shall be as per IRC as applicable to the location of the project. The carriage way shall be minimum 7.0 m for two lane and 3.75 m for single roads.
9.01.02	The shoulders of the roads shall be designed to support loaded trucks even in wet condition (as per IRC: 6 – for both Class AA and Class A).
9.01.03	The culverts shall be designed for class AA and class A loading of IRC. The concrete pipes shall be minimum class NP3 with/ without concrete surrounding, unless specifically relaxed by the Engineer-in-Charge.
9.01.04	The CBR value for the design shall be determined as per IS codes. Minimum 500 mm depth of the sub-grade of road/hard standings shall be compacted to 100% maximum dry density.
9.02.00	Flexible Pavements – General
	Flexible pavement roadwork shall consist of the following parts: bituminous concrete with a sealing or priming coat of bitumen on two layer stone wearing course; a cushion or binding layer to the surface of a soiling or base layer of stone and a sub-base of compacted soil. The total thickness of bituminous concrete sealing, wearing course, soiling/base layer shall comprise construction built up from the average formation level to the thickness shown on the drawings.
9.03.00	Sub-base or formation level
	The sub-base or formation level shall be prepared and compacted to the required level, in accordance with the Technical Specifications for earthworks in filling, and as shown on the drawings. Soft areas in the sub-base shall be removed and replaced with crashed stone, gravel of such material as directed by the Engineer-in-Charge. The sub-base shall be sloped at cross falls shown on the drawings to provide for effective drainage at all times. The sub-base shall be consolidated with a roller of capacity of 8 tones. The roller shall be run over the sub-base until the soil is evenly and densely consolidated to attain 95% of dry density at optimum moisture content of natural.
9.04.00	Base or Soling
9.04.01	Soiling with Stones

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	<p>Stone shall be clean, hard, free from decay and weathering. The maximum and minimum sizes of stones pieces shall be 225 mm and 100mm respectively to make the base or soling course of specified depth with a tolerance of ± 25 mm. Stone pieces brought to site of work shall be broke to the specified size with hammers and all kachha and rejected stones shall be separated out and removed away from site.</p>
9.04.02	<p>Laying of base or soling course</p> <p>The sub-base or formation shall be checked and approved by the Engineer-in-Charge before any soling stone shall be laid thereon. For a 225mm soling a 200mm layer shall be laid with the help of suitable templates. The stones in soling shall be hand packed with greatest length across the paving area. These shall be laid closely in positions on the sub-base, with its broadcast side downwards and to make up the specified thickness of base with single stones to correct slope. Projections in the stones which would result in excessive voids shall be knocked off with a hammer and/or selected stones used to fit the shape of the stones already laid. The joints shall be staggered. All interstices between stones shall be wedged in with smaller stones of suitable sizes, well driven-in to enable tight packing and complete filling of interstices. Such, filling shall be carried out simultaneously with the placing in position of soling rubble and shall not lag behind. All projecting corners above the surface level of the soling shall be rapped off with hammer to bring them into home. The surface shall be checked with template of approved design (to be provided by the Contractor) and high and low spots corrected by removing soling and repacking as specified above.</p>
9.04.03	<p>Consolidation of Base of Soling Course</p> <p>The soling shall be thoroughly consolidated with a roller of minimum 10 tones weight, starting at edges and working towards centre. The roller shall run over the same surface of soling for at least eight times until the soling course is well consolidated. The surface shall be checked by templates, corrected after every rolling and finally consolidated.</p>
9.04.04	<p>Cushion or Binding</p> <p>25mm thick or as specified layer of moorum or sand, free from excess of clay, as directed by the Engineer-in-Charge, shall be laid on top of the base or soling course. This shall be rolled so that the fine particles fill up the voids in the soling course.</p>
9.05.00	<p>Wearing Course</p>
9.05.01	<p>Material</p> <p>Wearing course material shall comprise stone, sand and fines and shall be clean, hard, and free from decay and weathering. The materials shall be mechanically stable natural gravel or crushed gravel or crushed stone.</p>
9.05.02	<p>Gravel</p> <p>The typical limits of particle size distribution for mechanically stable crushed or natural gravel for use as road wearing course with a nominal particles size of 37.5 mm shall</p>

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be:

Sieve Size	Percentage Passing (by weight)
37.5 mm	100
20 mm	80-100
10 mm	55-80
5 mm	40-60
2.36 mm	30-50
600 microns	15-30
75 microns	5-15

Not less than 10 percent should be retained between each pair of successive sieves, except for the two largest sieves listed for each of the four nominal maximum sizes of materials.

The two smaller sized materials (10mm and 5mm) may contain upto 35 percent of stones upto 37.5mm size provided that the material smaller than 5 mm is within the limits shown.

Well-rounded gravels with grading smaller to the 37.5mm nominal maximum size must be crushed to give 40 percent of their stones angular forces.

9.05.03 Crushed Stone

Typical limits for particles size for all-in crushed stone material for use as a road wearing course shall be:

Sieve Size	Percentage Passing (by weight)
50 mm	100
37.5 mm	95-100
20 mm	60-80
10 mm	40-60
5 mm	25-40
2.36 mm	15-30
600 microns	8-22
75 microns	5-12 (Note)

The percentage passing the 75 microns sieve should be chosen carefully according to the grading and plasticity of this fraction. If the PI of the fines approaches the upper limits of 6, it is desirable that the fines content is restricted to the lower end of the range. For material with non-plastic fines, the proportion passing the 75 microns sieves should approach 12 percent. The aim should be to achieve the maximum impermeability compatible with good compaction.

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9.05.04	<p>Laying of Wearing Course</p> <p>The base of soling course shall be checked by the Engineer-in-Charge before the wearing course shall be laid thereon. The wearing course shall be laid to the dimensions and cambers on the drawings in two layers each of 115mm laid thickness each compacted to 75 mm thickness giving a combined thickness of 150mm and shall be laid with the aid of suitable templates. The second or top layer shall not be started until the lower layer has achieved its necessary composition and is true to level by ± 25mm. The top course shall be similarly compacted to achieve a level within a tolerance of ± 15mm.</p> <p>Since graded materials when dry tend to segregate during transportation and spreading, they shall be kept well damped during these operations.</p>
9.05.05	<p>Compaction of wearing courses</p> <p>Compaction shall be achieved by using a smooth type roller of weight not less than 3 tones weight, in a similar manner to that for consolidating the soling or base course.</p>
9.06.00	Bituminous Macadam Surfacing
9.06.01	<p>Materials</p> <p>The manufacture and grading of the bitumen macadam shall be in accordance with IS: 73 (latest revision) except where stated otherwise in this specifications.</p>
9.06.02	<p>Aggregate</p> <p>Coarse aggregate shall be hard, clean and durable crushed igneous rock from a source to be approved by the Engineer-in-Charge.</p> <p>Fine aggregate shall be quarry fines produced from the crushing of igneous rock in a secondary plant. They are to consist of hard, non-absorbent, moderately sharp particles and to be free from clay loam and other foreign matter.</p> <p>If filler is used, it shall consist of finely ground particles of hydrated lime, Portland cement or crushed rock and at least 75% of the filler shall pas a 75 microns sieve.</p>
9.06.03	<p>Binder</p> <p>The Binder shall be straight-run bitumen with a penetration of 80/100 at 25 degree C. Representative samples of all materials proposed for use under these specifications shall be submitted to the Engineer-in-Charge by the Contractor for test and for preparation of trial mixes to determine job-mix formula. The Engineer-in-Charge shall make tests of the proposed materials and inform the Contractors if the tests indicate compliance with the Specifications.</p> <p>The grading of the combined aggregate to be used in the respective mix shall be within the limits stated below and when plotted graphically with the particle size to a logarithmic scale shall lie on a smooth curve within the envelope of these limits.</p>

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Typical grading limits for dense Bitumen macadam for use in surface courses of 25mm – 32 mm.

Sieve Size	Percentage Passing (by weight)
20 mm	100
14 mm	95-100
10 mm	70-90
6.3 mm	45-65
2.35 mm	30-45
1.18 mm	15-30
75 microns	3-7

The exact job-mix formula will depend on the nature and grading of the aggregate and the type of bitumen. The exact job-mix formulae will be determined by the Engineer-in-Charge.

9.06.04 Primer

The primer for the surface of the wearing course shall be MC 30 or MC 70 cut-back bitumen or as directed by the Engineer-in-Charge.

9.07.00 **Workmanship**

9.07.01 General

The materials shall be mixed in an approved mixer of batch or continuous type, from which mixed materials can be delivered and laid hot.

The mixing plant shall be maintained in good working condition and shall be subject to inspection by the Engineer-in-Charge. The weighing, measuring and recording apparatus shall be checked at frequent intervals and maintained in perfect adjustment through out the contract.

The aggregate and binder shall be heated separately, aggregate to a temperature range of 120-150 degree C and the binder to 135 degree C. The respective temperatures of the aggregate and the binder are to be within 15 degree C of each other at the time of mixing.

Prolonged and excessive heating of the materials is to be avoided and particular care is to be taken with binders. A dry mixing period of at least 10 seconds shall precede the addition of bitumen to the mix. Wet mixing shall only continue as long as is necessary to obtain a thorough head.

Aggregate, including fillers, if any shall be thoroughly dried immediately before mixing. When moisture is detected in the mixed materials all aggregates in the hot bins are to be removed and replaced in their respective stockpiles.

The mixed materials shall be transported from mixing plant to site in clean metal lined vehicles. Every precaution is to be taken to avoid segregation of mixed materials and to

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	<p>ensure that they do not become contaminated with dust or foreign matter. Should any loads be wetted excessively by rain they will be rejected by the Engineer-in-Charge.</p>
9.07.02	<p>Bitumen Macadam/Preparation of Surface prior to laying</p>
	<p>Before the macadam is laid on the newly constructed wearing course, the surface will be inspected by the Engineer-in-Charge and testing using an engineer's level, or any other means to ensure that the surface conforms to the requirements of this specification. Any irregularities in the surface shall be corrected to the satisfaction of the Engineer-in-Charge before surfacing work will be allowed to proceed.</p>
9.07.03	<p>Priming the Wearing Course-Layer</p>
	<p>Immediately prior to the laying of the primer, the surface of the wearing course shall be swept clean of all loose and caked dirt or other material adhering to the prepared surface. Where there is a tendency to dusting, the surface of the wearing course shall be damped with a water spray to assist the penetration of the primer.</p>
	<p>The primer shall be laid at the rate of between 0.5 lit/sq.meter and 1.0 lit/sq.meter. The exact rate shall be determined by the degree of absorbency of the surface. The criteria will be determined by field testing and shall be chosen such that the primer penetrates the surface of the wearing course to a minimum of 3mm and a maximum of 6mm taken over an average area of 10 sq. metres. The surface shall have dried to a matt surface in 24 to 84 hours and no ponding of free bitumen shall be seen on the surface.</p>
	<p>The primer shall be sprayed by mechanical plant by workmen who have been trained to achieve the agreed rate of coverage.</p>
	<p>The primer shall have dried to the condition of the trial panel before any laying of the Bituminous Macadam is commenced.</p>
	<p>These tests will be carried out by the Contractor in the presence of the Engineer-in-Charge.</p>
9.07.04	<p>Bitumen Macadam Laying</p>
	<p>After mixing, the material must not be reheated other than by the means provided in or on the spreading machine.</p>
	<p>Material must not be laid when the surface on which it is to be placed is wet or when rain appears imminent. Immediately prior to laying the Bitumen Macadam, the surface of the base course shall be swept clean of all loose and caked dirt. The Macadam as specified shall be laid by approved means to compacted thickness of 25 mm course.</p>
	<p>It is essential that the material is laid at a temperature not less than 110 degree C and not more than 150 degree C. The contractor is to provide at each spreader and finisher a suitable thermometer for testing the temperature of the material as it is being spread and is to take such temperature reading continually and record them hourly throughout each days laying. This record shall be available for inspection by the Engineer-in-Charge who will himself make such additional temperature checks as he considers desirable.</p>

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Clause No.	CONSTRUCTION OF ROADS & HARD STANDINGS / PAVING
9.07.05	<p data-bbox="386 338 586 369">Hand Spreading</p> <p data-bbox="386 390 1451 552">Where hand spreading and tamping is to be proposed, the mixed material is to be dumped on delivery upon an existing hard clean surface or on approved metal sheets outside the area where it is to be spread and shall be distributed into place immediately by hot shovels. It shall be spread with hot rakes in a uniformly loose layer to the full depth required.</p> <p data-bbox="386 573 1451 800">As soon after laying as conditions permit and when the material is still at a temperature of not less than 95 degree C, the materials will be uniformly compacted with 3 wheeled smooth rollers by rolling in a longitudinal direction, progressing gradually from side to centre of work and so lapping the rolling as to obliterate all roller marks on completion. A sufficient number of rollers shall be employed to ensure that the entire surfacing as laid is compacted at the correct temperature. The weight of the roller shall be similar to that for mechanical spreading and finishing.</p>
9.07.06	<p data-bbox="386 842 894 873">Bitumen Macadam Spreader and Finisher</p> <p data-bbox="386 894 1451 1184">Where mechanical spreading is proposed, the materials shall be laid by approved mechanical spreaders and finishers. The spreader and finisher shall be in good mechanical condition and shall be capable of laying to the required width and profile without causing segregation, dragging, burning, irregularities or other surface defects and it shall be capable of being operated at a speed consistent with the character of the mixture and the thickness of the course being laid so as to produce a surface having a uniform density and surface texture. When not operated on side forms, the spreader will employ equalizing runner, eveners arms or other automatic compensating devices to adjust the profile and confine the edges of the course to true lines.</p> <p data-bbox="386 1205 1451 1304">The mixer capacity and the operating speed of the spreader shall be adjusted as to ensure continuous laying and to avoid intermittent stopping of the spreader so far as is practicable.</p> <p data-bbox="386 1325 1451 1677">At least two rollers are to be provided. One roller is to be three wheeled and is to have a weight per 25 mm width of rear wheel of between 110 kg and 100 kg. The second roller shall preferably be a pneumatic – tyred roller and shall be multiple axle, multiple-wheel type with smooth tread pneumatic tyres of equal size staggered on the axles at such spacing and overlaps as will provide uniform compactive pressure for the full compacting width of the roller when operating. Oscillation of the wheels, if provided, shall be in vertical plane only. The pneumatic tyred roller shall be capable (A) of being ballasted sufficiently to bring its load weight to at least 2.5 times its own weight. Gross weight to be preferably 20-30 tones and (B) of exerting compactive ground pressures of at least 80 pounds per square inch. For the pneumatic rollers compaction should be done within 65-80 degrees C range.</p> <p data-bbox="386 1698 1451 1759">All roller wheels are to be kept slightly moist by the use of water tanks and spray bars attached to the machines to prevent the material being picked up or disturbed.</p> <p data-bbox="386 1780 1451 1841">Rollers must not be left standing on the new surface while there is any risk of it being damaged thereby.</p> <p data-bbox="386 1862 919 1894">The sequence of rolling operations shall be:</p>

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	<ul style="list-style-type: none"> a) Breakdown rolling with the 3 wheeled smoother roller. b) Intermediate rolling with the high pressure typed pneumatic roller. c) The final rolling with a steel wheeled density is obtained. <p>Rolling will continue until the specified density is obtained.</p>
9.07.07	<p>Field Density of Compacted Bitumen Macadam</p> <p>Density tests of the Bitumen Macadam surfacing after compacting shall be taken from the trial area and later on intervals throughout the course of the work and compared with the density of control specimens taken from the same material before laying in accordance with the following procedure:</p> <ul style="list-style-type: none"> i) A sample of mixed material will be taken from a lorry before the material is delivered to the spreader, and two control specimens shall be made and their density measured by the Engineer-in-Charge by the Marshal Method. The average of the two specimens will be taken as the control density of that particular batch. ii) The pavement will be marked to show where the lorry load of material (from which the sample was taken) is laid, so that field density samples can be taken for comparison with the control specimens. iii) After completion of rolling, two samples are to be cut from each area so marked in position indicated by the Engineer-in-Charge. iv) The samples shall be taken and the density calculated by weighting in air and weighing in water. The average of the two samples will be taken as the density of the compacted material in the area. v) It is essential that the surface of the road is free from waves; any depressions which retain water on the surface are immediately to be corrected as described above to the satisfaction of the Engineer-in-Charge.
9.07.08	<p>Joints</p> <p>All joints shall be vertical, properly formed to the correct line and level if necessary, they shall be cut back to achieve this. The exposed edges of the Bitumen Macadam already laid shall be coated thinly with Bitumen emulsion containing 30% to 50% Bitumen before laying adjoining work. All joints on completion shall present the same texture, density and smoothness as other sections on the surface.</p> <p>Surface and projections, which the new paving will about, shall be thoroughly cleaned and coated with Bitumen emulsion containing 30-50% Bitumen. The new paving shall then be tamped around and against the projection to such a depth that, on completion of compaction the finished surface of the wearing course is level with the top of the projection.</p>
9.07.09	<p>Premix and Seal Coat</p> <p>A premix and seal coat shall be applied immediately after laying the carpet and rolled using 0.6 m³ of sand and 68.3 kg of binder per 1000 sq.m of ground surface. Finally sand shall be spread on the road surface at the rate of 0.3 m³/100 m² and traffic may be</p>

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	<p>allowed on the road 24 hours after providing the seal coat. During the period, back rolling shall be carried out.</p>
9.07.10	<p>Damaged Work</p>
	<p>Should the new bitumen macadam be dragged, churned up, become soft, shows signs of segregation, shows that the stripping of the binder from the aggregate has occurred, or suffer other damages during or after being laid, the Contractor will remove the damages or faulty work and replace with fresh material, laid and compacted to the correct level to the satisfaction of the Engineer-in-Charge.</p>
9.08.00	<p>Tests</p>
	<p>The contractor shall provide equipment, labour and such trained staff as may be required by the Engineer-in-Charge for carrying out the following tests on materials to be used in the manufacture of Bitumen Macadam in accordance with the Indian Standards</p>
	<ul style="list-style-type: none"> i) Grading tests on aggregate with Indian Standard on "Sampling and Testing of Mineral Aggregates and Fillers". ii) Determination of binder content of mixed materials in accordance with hot extraction method – Indian Standard on "Sampling and Examination of Bituminous Road Mixtures". The attention of the Contractor is particularly drawn to the necessity of providing results in duplicate. This means that two sets of apparatus are essential if this method of extraction is used.
	<p>Aggregates shall be sampled and tested on delivered to the mixing plant and after each extraction test and the result of each test shall be submitted to the Engineer-in-Charge within 24 hours of the sample being taken. The number of such tests shall be adequate for proper control of the materials and shall not be limited to those made on specific instructions of the Engineer-in-Charge. Samples of mixed materials shall be taken and tested during the first days mixing and throughout the work to confirm that the grading and binder contents are as specified.</p>
	<p>Such samples shall be taken either at the place and time of mixing or at the place of laying as directed by the Engineer-in-Charge. Samples for testing shall also be cut from the surfacing as laid when directed by the Engineer-in-Charge.</p>
	<p>The frequency of sampling mixed materials shall be at least once per day or once per 100 tones of material mixed whichever is the more frequent. The result of each test on mixed materials shall be submitted to the Engineer-in-Charge within 24 hours of the sampling and any adjustments shown to be necessary shall be made immediately. Until such adjustments have been made and until a certificate to the effect has been forwarded to the Engineer-in-Charge, no further batches of mixed material shall be made.</p>
	<p>Independent sampling and testing may be carried out by the Engineer-in-Charge throughout the contract period and for this purpose, the contractor shall grant free access to the mixing plant and storage depots, supply materials and provide every facility for the Engineer-in-Charge to take samples wherever required.</p>
	<p>In particular, throughout the contract, the Engineer-in-Charge will carryout control tests</p>

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	<p>on the plant mix as he requires.</p> <p>The Engineer-in-Charge shall be supplied with all necessary equipment, labour and materials to perform any additional test he may wish to carry out.</p> <p>A certificate is to be obtained from the suppliers with each consignment of bitumen delivered; stating the grade of material being supplied, and these certificates are to be handed over to the Engineer-in-Charge.</p> <p>Notwithstanding the production of any manufacturer's test certificates if the Engineer-in-Charge requires, the contractor shall arrange for the testing in an approved manner of all materials used throughout the contract to ensure that they are upto the standard specified. The Contractor shall arrange for the testing of materials incorporated in the works to ensure that they have been manufactured or supplied as specified or as ordered by the Engineer-in-Charge.</p> <p>Whenever the contractor intends to carry out any of the above test, he shall give the Engineer-in-Charge sufficient notice to enable him, should he so wishes, to be present during the test. The Engineer-in-Charge shall be given the results in writing of all tests as soon as they are available and in any case not later than 24 hours after samples have been taken.</p> <p>Wherever the contractor takes samples for testing, and where so directed he is to take duplicate samples and hand them to the Engineer-in-Charge. Such samples are to be properly packed and labelled as directed.</p>
9.09.00	In-situ concrete paving
9.09.01	<p>General</p> <p>Except where otherwise shown on the drawing paving work shall consist of 3 parts, viz. Base slab, sub-base and compacted and dressed sub-grade. The work shall include furnishing of all labour, material and equipment necessary to complete the paving work as described herein. The scope for work does not include cleaning, cutting, bending, laying and binding of reinforcement work.</p>
9.09.02	<p>Sub-grade</p> <p>The sub-grade shall be prepared and compacted upto required level, a soft area in the sub-grade shall be removed and replaced with crushed stone, gravel or such material as directed by the Engineer-in-Charge. The formation surface of the soling course shall first be cut to the required depth to below the finished level and dressed off parallel to finished profile, surplus earth shall be disposed of, levelled and dressed as directed by the Engineer-in-Charge. The sub-grade shall be sloped to provide for effective drainage in the area.</p> <p>The sub-grade shall be compacted with light roller of capacity 3 tones. The roller shall be run over the sub-grade till the soil is evenly and densely compacted to attain 95% of dry density at optimum moisture of natural soil as decided by the Engineer-in-Charge. All undulations in the surface that develop due to rolling shall be made good with earth or quarry spoils as the case may be and the sub-grade shall be re-rolled to the satisfaction of the Engineer-in-Charge.</p>

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9.09.03	<p>Sub base</p> <p>The PCC layer of sub base shall be laid on the compacted sub grade to give a plain surface ready for receiving the base slab. The minimum thickness of P.C.C sub base shall be 100 mm or as shown in drawings and shall be concrete of 1:4:8 proportions (with 40 mm size coarse aggregate).</p>
9.09.04	<p>Base Slab</p> <ul style="list-style-type: none"> i) The base slab shall be as structural concrete slab with or without reinforcement. For all concrete work, the relevant clauses of the Technical Specification for cement and concrete work of this specification shall be deemed to form part of the paving specification also. ii) Joints <ul style="list-style-type: none"> a) Isolation joints shall be provided at junctions with walls, columns, machine foundations and footings or other pints or restrain. These joints shall be filled with preformed bitumen impregnated fibre boards conforming to IS: 1838 (latest edition). Control joints shall be spaced at 5 to 6 m intervals along the length and shall be capable of accommodating differential movements in the plane of the slab caused by drying, shrinkage and thermal gradient across the thickness. The control joints may be formed either by sawing or by pressing a T section of mild steel while the concrete is still in the plastic stage. Control joints shall be filled with hot applied sealing compound conforming to IS: 1834 (latest edition). b) Expansion joints shall be spaced as shown on the drawings or at intervals of 25 to 30 metres and the clear gap between the adjacent slabs shall be provided for the full depth. <p>The clear gap shall be filled with expansion joint filler which is compressible enough to accommodate the expansion.</p>

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Clause No	SUPPLY & LAYING OF R.C.C. PIPES
SECTION – 11	
11.00.00	SUPPLY AND LAYING OF R.C.C. PIPES
11.01.00	<p>Scope</p> <p>This specification covers the supply and laying of R.C.C. Hume pipes as may be required. The entire work shall be carried out as per latest editions of Indian Standards IS: 783 and IS: 458.</p>
11.02.00	<p>Supply of Pipes</p> <p>The Contractor shall supply the R.C.C. Hume pipes of various diameters along with complete fittings required for carrying out the work. R.C.C. Hume pipes should conform to class NP3/ NP2 of IS: 458 as may be required and should be in good condition. The Contractor shall furnish, on being demanded by the Engineer-in-Charge, manufacturer's certificates and/or test certificates from recognised authorities.</p>
11.03.00	<p>Alignment, Levels and Grade</p> <p>The work shall be carried out in conformance to the alignment, levels and grades specified in the drawings. The layout and levels shall be made by him at his own cost from one reference grid and bench mark given by the Engineer-in-Charge. He shall give all help in instruments, materials and men to the Engineer-in-Charge for checking the detailed layout and levels as and when required.</p> <p>Making of reference layout and level pillars along the pipeline route and maintaining them upto completion of the work shall be the responsibility of the Contractor. No extra payment shall be made for these.</p>
11.04.00	Laying of Pipes
11.04.01	<p>The laying of R.C.C. pipes shall conform to Clause 9 of IS: 783.</p> <p>Conditions for Laying</p> <p>The conditions for laying of pipes to suit the conditions at site and/or as per drawings and instructions of the Engineer-in-Charge shall be as classified below:</p> <ol style="list-style-type: none"> Culvert Condition <p>In this condition the pipe is laid under embankment and may project wholly or partly above the original ground surface.</p> Trench Condition <p>In this condition the pipe is laid in a trench excavated for the purpose. The trench shall be refilled with thoroughly tamped earth after laying and joining of pipes in approved manner.</p> Open Condition <p>In this condition the pipe is laid such that it projects wholly or partly above</p>

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Clause No	SUPPLY & LAYING OF R.C.C. PIPES
	original ground surface, there being no super imposed overburden on pipe.
11.05.00	Bedding and Supports
11.05.01	Culvert Condition In this condition the pipes shall be laid generally on 'First Class Bedding' as per Clause No. 4.3.3 or IS: 783, unless directed otherwise.
11.05.02	Trench Condition In this condition the pipes shall be laid generally on 'First Class Bedding' as per Clause No. 4.2.3 of IS: 783, unless directed otherwise.
11.05.03	Concrete Cradle Bedding If required by the drawing or so instructed by the Engineer-in-Charge, the pipes shall be laid on concrete cradles, conforming to Clause No. 4.2.4 of IS: 783 in case of trench condition and conforming to clause No. 4.3.4 of IS: 783 in case of culvert condition.
11.05.04	Open Condition In open condition the pipe laid shall be supported over rigid pedestals constructed at intervals not greater than the length of one individual piece of pipe, as per drawings and instructions of the Engineer-in-Charge. In no case shall the joint between two pieces of pipe shall lie at the centre of span between the supports. The pedestals shall be of rubble masonry or brick masonry or plain/reinforced concrete with a properly shaped out top to receive the pipe.
11.06.00	Jointing of Pipes Clause 10 of IS: 783 shall be applicable for jointing of pipes and every possible care shall be taken. The Contractor shall ensure that the joints made are leak proof. Curing of joints shall be done for a period of 10 days. No extra payment shall be made for making and curing of joints. At the exposed end, the joint shall be sealed with approved sealing compound, to a depth of at least 25mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

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Clause No.	PAINTING & ALLIED WORKS
SECTION – 13	
13.00.00	PAINTING AND ALLIED WORKS
13.01.00	Scope
	<p>This specification covers painting, Distempering, wall finishing etc. of both interior and exterior surfaces of masonry, concrete, plaster, structural and other miscellaneous steel items, external surface of over ground water pipes, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and nonferrous metal items as shown on drawings or as directed by the Engineer-in-Charge.</p> <p>If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the Contractor shall notify the Engineer-in-Charge in writing or assure responsibility for and rectify any unsatisfactory finishing that results.</p> <p>Before commencing painting, finishing, the Contractor shall obtain the approval of the Engineer-in-Charge in writing regarding the scheduling of work to minimise damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations.</p>
13.02.00	Materials
13.02.01	<p>Materials shall be highest grade products of well known approved manufacturer and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name, and colour shade, with labels intact and seal unbroken. All materials shall be subject to inspection and approval by the Engineer-in-Charge. It is desired that the materials of one manufacturer only shall be used as far as possible and paint of particular shade be obtained from the single batch. All paints shall be subjected to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer-in-Charge.</p> <p>All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.</p> <p>All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest Indian Standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer-in-Charge.</p> <p>All colours shall be as per painting/finish schedule and tinting and matching shall be done to the satisfaction of the Engineer-in-Charge. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer-in-Charge.</p>
13.02.02	<p>Synthetic Enamel Paint</p> <p>Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give smooth, hard, durable and glossy finish to all exterior and interior surfaces. White and pastel shades shall resist yellowing and darkening with</p>

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	ageing. The paint shall conform to IS: 2932 and IS: 2933.
13.02.03	<p>Waterproof Cement Paint</p> <p>Shall be made from best quality white cement and lime resistant colours with accelerators, water-proofing agents and fungicides. The paint shall conform to IS: 5410.</p>
13.02.04	<p>Dry Distemper</p> <p>Dry distemper of required colour conforming to (IS: 427) and of approved brand and manufacturer shall be used. The primer where used shall be cement primer or distemper primer. These shall be of same manufacturer as that of distemper.</p>
13.02.05	<p>Acrylic Emulsion Paint</p> <p>Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, should be able to withstand washing with mild soap and water without any deterioration in colour or without showing flaking, blistering or peeling.</p>
13.02.06	<p>Oil Bound Distemper</p> <p>Oil bound distemper (15:428:19690) of approved brand and manufacturer shall be used. The primer where used be cement primer or distemper primer. These shall be of same manufacturer as that of distemper. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.</p>
13.02.07	<p>Chemical Resistant Paint</p> <p>Chemical resistant paint as per IS: 157 of approved brand and manufacture shall be used. Primer coat to be used shall be as per manufacturer's specifications.</p>
13.02.08	<p>Fire Resisting Paint</p> <p>Fire resisting paint (silicate type) shall be as per IS: 162 and of approved brand and manufacture. Primer to be used shall be as per manufacturer's specifications.</p>
13.02.09	<p>Oil Resistant Paint</p> <p>Oil resistant paint shall be as per IS: 161 and of approved brand and manufacturer. Primer coat shall be as per manufacturer's specifications.</p>
13.03.00	<p>Storage</p> <p>The Contractor shall arrange for safe and proper storage of all materials and tools. Paints shall be kept covered at all times, and mixing shall be done in suitable containers. All necessary precautions shall be taken by the Contractor against fire</p>

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Clause No.	PAINTING & ALLIED WORKS
	hazards.
13.04.00	Preparation of Surface Before starting the work the Contractor shall obtain the approval of the Engineer-in-Charge regarding the soundness and readiness of the surface to be painted on.
13.04.01	Masonry, Concrete and Plastered Surface Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleared out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaced area shall be treated with minimum one coat of cement primer which should be continued to the surrounding area for a distance of minimum 100mm. Surface with mildew and efflorescence shall be treated as below: <ul style="list-style-type: none"> a) Mildew All mildew surfaces shall be treated with an approved fungicide such as ammonical wash consisting of 7g. of copper carbonate dissolved in 80 ml liquid ammonia and diluted to 1 litre with water, or 2.5 per cent magnesium silico fluoride solution and allowed to dry thoroughly before paint is applied. b) Efflorescence All efflorescence shall be removed from affected surfaces with a solution of muriatic acid in water (1:6 to 1:8), washed fully with clear water and allowed to dry thoroughly.
13.04.02	Metal All metal surfaces shall be absolutely clean, dry and free from wax grease and soap films. All steel and iron surfaces in addition shall be free from rust. All galvanised iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat.
13.05.00	Application
13.05.01	General The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 metre square as per instruction of the Engineer-in-Charge and obtain his approval prior to application of finishing paints. Proper tools and implements shall be used. Scaffoldings if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes. Painting shall be done by skilled labours in a workman like manner. All materials shall be evenly applied, so as to free of sags, runs crawls or other defects. All coats shall be

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	<p>of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paints. All priming undercoats for painting shall be applied by brush only, and rollers, spray equipments etc. shall not be used.</p> <p>No work shall be done under conditions that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint which seals the surface to moisture shall only be done after the moisture on and below the surface has dried out.</p> <p>All coats shall be thoroughly dry before being sand papered or before the succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specified number of coats, further coats shall be applied by the Contractor when so directed by the Engineer-in-Charge.</p> <p>All primer and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.</p>
13.05.02	<p>Synthetic Enamel Paint</p> <p>Shall be applied on properly primed surface. Subsequent coat shall not be applied till the previous coat is dry. The previous coat shall be lightly sand papered for better adhesion of subsequent coats.</p>
13.05.03	<p>Waterproof Cement Paint</p> <p>Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours), the second coat shall be applied.</p> <p>In a similar manner the finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.</p>
13.05.04	<p>Dry Distemper</p> <p>New plastered surface shall be allowed to dry for at least two months. New lime or lime plastered surface shall be washed with a solution of 1 part of vinegar to 12 parts water or 1:50 sulphuric acid solution and left for 24 hours after which the wall shall be thoroughly washed with clean water. For cement plastered surface, the surface shall be washed with a solution of 100 gms of zinc sulphate to 1 litre of water and then allowed to dry.</p> <p>Dry distempering shall be done as per manufacturer's instruction. In applying the distempers, the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long as otherwise marks may result.</p>

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Clause No.	PAINTING & ALLIED WORKS
13.05.05	<p>Acrylic Emulsion Paint</p> <p>Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer-in-Charge. Painting shall be strictly as per manufacturer's specification.</p>
13.05.06	<p>Oil Bound Distemper</p> <p>Any unevenness in surface shall be made good by applying putty. The patched surface shall be allowed to dry thoroughly before the coat of distemper is applied. One coat of distemper properly diluted with thinner as specified by the manufacturer shall be applied by brushes in horizontal strokes followed immediately by vertical ones which together will constitute one coat. Two or more coats of distemper as found necessary shall be applied to obtain even shade.</p>
13.05.07	<p>Chemical Resistant, Fire Resistant and Oil Resistant Paints</p> <p>In general, method of application of these paints shall be strictly as per manufacturer's specifications.</p>
13.06.00	<p>Painting of Iron Work</p>
13.06.01	<p>Paint to be used for various items of work shall be of best quality and shall be obtained ready mixed in sealed containers from approved manufacturer. The Contractor shall obtain the Engineer-in-Charge's approval for the make and colour of the paint he proposes to use.</p>
13.06.02	<p>All surfaces shall be thoroughly cleaned of all dirt, loose particles and rust and approved prior to application of paint. Workmanship shall conform to IS: 1477 (Part I & II).</p>
13.06.03	<p>Specified number of coats shall be applied and at least 24 hours shall elapse between the applications of successive coats. No painting shall be carried out on exterior work in wet weather or on surfaces which are not entirely dry.</p>
13.06.04	<p>Painting rate shall include all necessary scaffolding, cradles and plant.</p>
13.07.00	<p>Protection</p> <p>Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of the painting work. All stationary items of equipments shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protection shall be as per instruction of the Engineer-in-Charge.</p>
13.08.00	<p>Cleaning up</p> <p>The Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all</p>

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Clause No.	PAINTING & ALLIED WORKS
	equipments fixtures, glass, furniture, fittings, etc. to the satisfaction of the Engineer-in-Charge.
13.09.00	Acceptance Criteria
13.09.01	All painted surfaces shall be uniform and pleasing in appearance.
13.09.02	The colour, texture, etc. shall match exactly with approved samples.
13.09.03	All stains, splashes and splatters of paint shall be removed from surrounding surfaces.
13.10.00	Painting of Structural Steel/Miscellaneous Steel
13.10.01	Scope This specification covers painting of the structural/miscellaneous steel supplied and erected either by other agencies or by the Contractor for work under the scope of this contract. One shop coat of red oxide zinc chromate primer including necessary touching up has already been completed by the concerned agency. One coat of red oxide zinc chromate primer followed by a coat of undercoating and two or more finishing coats of synthetic enamel paint as described hereunder are only required to be provided under the item for painting structural/miscellaneous steel.
13.10.02	Type of Structural member to be Painted Painting shall be done on all exposed surfaces (including undersides wherever exposed) of various structural steel members like columns, trusses, beams, coal bunkers, oil tanks, trestles, bracings, crane girders, chequered plates, gratings, brackets, base plates etc. in the plant as directed by the Engineer-in-Charge. It should be clearly noted that all structures are already erected/placed in position, hence the quoted rate by Contractor shall account for all aspects involved in painting keeping in view the heights, available access to members etc. It is advised that the Contractor should visit the site and get himself acquainted with the nature of work completely including the extent and type of scaffoldings etc. required, before quoting his rate.
13.10.03	Material Paint shall be synthetic enamel paint conforming to IS:2932 of approved colour and brand.
13.10.04	Painting
13.10.05	In general, painting work shall be in accordance with IS: 1477 (Part I & II).
13.10.06	Surface of steel work to be painted shall be thoroughly cleaned of all grease, oil, dirt, rust, foreign matter like cement splashing, etc. by suitable solvent and mild rubbing with abrasive paper/hand scrapping to the full satisfaction of the Engineer-in-Charge. Cleaning with solvents/scrapping shall be limited to the affected areas only.

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Clause No.	PAINTING & ALLIED WORKS
13.10.07	In case where the existing primer is removed while cleaning the surface as detailed in 12.6 damaged portions shall be provided with a coat of wash or etching primer on suitable chemical pre-treatment solutions and another coat of red oxide.
13.10.08	<p>After the surface is prepared in a manner described above, the primer coat shall be dry cut without scratching or in any way damaging the primer coats and clean the surfaces from dust.</p> <p>Over this dry surface apply an optimum coat of undercoating (synthetic enamel paint) by urban or spray with minimum brush marks. Allow the film to dry hard, wet rub, cutting down to a smooth finish (ensuring that at no place the undercoat is completely removed). Allow the water to evaporate.</p>
13.10.09	Finishing coats shall consist of two coats of synthetic enamel paint of approved colour and brand. The second coat, if so directed by Engineer-in-Charge, shall be applied only after the first coat is hard dry, its gloss is gently removed over the entire surface and dusted off.
13.10.10	The total dry film thickness of each coat shall be not less than 25 microns.
13.10.11	The paint shall be applied by brushing/spraying. Spraying shall be adopted with prior approval of Engineer-in-Charge generally on large surface areas. Paint shall be stirred frequently to keep the pigment in suspension. Paint shall be ready mixed in original sealed containers as packed by the paint manufacturers and no thinners shall be permitted. No painting shall be done in frosty/foggy rainy weather or when humidity is high enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of the surface to be painted is 5 deg. Centigrade or lower.
13.10.12	Contractor shall provide and use sufficient number of drop clothes, covers, tarpaulins and other screens to protect adjacent surfaces and shall remove all splatter and stains from such surfaces. The Contractor shall also protect his own work.
13.10.13	Any and all damage to adjacent work or any part of the premises due to painting carelessness or accidental performance of the Contractor shall be repaired or made good at the Contractor's expense.
13.10.14	Painting shall be discontinued when exposed to rain and dust storm and shall not commence until the surfaces are perfectly dry and clean. Wherever practicable, surfaces shall be painted when in shade or when temperature is falling.
13.10.15	<p>Cleaning up.</p> <p>The Contractor, upon completion of painting etc. shall remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipments fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer-in-Charge.</p>

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Clause No.	PAINTING & ALLIED WORKS
13.10.16	<p data-bbox="386 338 625 365">Acceptance Criteria</p> <ul data-bbox="386 390 1448 556" style="list-style-type: none"><li data-bbox="386 390 1268 420">(i) All painted surfaces shall be uniform and pleasing in appearance.<li data-bbox="386 443 1321 472">(ii) The colour, texture etc. shall match exactly with the approved sample.<li data-bbox="386 495 1448 556">(iii) All stains, splashes and splatters of paint shall be removed from surrounding surfaces.

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Clause No.	GRADING AND METALLING
SECTION-15	
15.00.00	GRADING AND METALLING
15.01.00	Scope
	This section covers the supply of murram/coarse sand and stone ballast and furnishing all labour and T&P and performing of all operations necessary for preparing the sub grade and spreading the murram/coarse sand and stone ballast in Switchyard Area.
15.02.00	Materials
15.02.01	Murram shall be coarse and good quality. The quality of murram used shall be got approved by the Engineer-in-Charge. The coarse sand conforming to relevant IS code can also be used in place of murram.
15.02.02	The stone ballast shall conform to IS: 383 (latest). The ballast shall be of nominal size 20mm. The ballasts passing through 10mm sieve shall not be used. The ballast shall not be weathered and shall not contain any foreign or deleterious material.
15.03.00	Excavation and Filling
15.03.01	Any 'Excavation' or 'Filling' required to bring the sub-grade to specified level shall be carried out as specified under these items.
15.04.00	Sub-Grade
15.04.01	The sub-grade shall be prepared by removing grass and other vegetation and by dressing the surface to make the area level and even without being way. If required/ desired by the Engineer-in-Charge, water shall be sprinkled and the surface rolled with alight roller. The suitability of sub-grade shall have the approval of the Engineer-in-Charge before spreading murram/coarse sand and stone ballast.
15.05.00	Metalling / Paving
15.05.01	The required quality of murram/coarse sand and stone ballast shall be brought to site and stored in regular stacks.
15.05.02	First 100mm thick layer of murram/coarse sand shall be laid over prepared sub-grade. The spreading shall start from one end by taking the materials from successive stacks. The layer of murram/coarse sand shall be properly watered, compacted and levelled. The thickness of levelled and compacted layer shall not be less than specified.

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Clause No.	GRADING AND METALLING
15.05.03	<p>Over layer of murram/coarse sand, 100mm thick layer of stone ballast/metal shall be laid. The spreading of ballast shall be started from one end by taking the materials from successive stacks. The spread ballasts shall be levelled by rakes etc. It should be laid slightly higher than the finished level and brought to the specified level by tamping. The finished surface shall be regular, uniform and even.</p>

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Clause No.	SWITCHYARD CIVIL WORKS
3.09.00	<p>Bolting</p> <p>a) Every bolt shall be provided with a steel washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.</p> <p>b) Notwithstanding any thing to the contrary contained in IS:1363 (late revision) and IS:1367 (latest revision), the unthreaded length of the bolt shank shall be equal to total thickness of metal being bolted together plus 2mm. The threaded length shall be equal to at least the diameter of bolt plus 6mm.</p>
3.10.00	<p>Cable and pipe trenches shall be in RCC with removable RCC covers. The work also includes excavation and backfilling. The top of trench shall be kept 75mm above the grade level. The bed of trenches shall be given a slope to drain water into a collection sump at suitable location, as directed by the Engineer-in-Charge. The cable trenches/pipe trenches shall be given a slope of 1 in 200 in the direction perpendicular to the run of the trenches. All trenches shall be given a slope of 1 in 500 along run of the trench.</p>
3.11.00	<p>The design of foundation and all trenches should take care of any sub-soil water pressure that may be encountered. The design shall be as per relevant IS codes. No foundations shall rest on filled up soil. All foundations shall be founded at a level at least 500 mm below the virgin soil.</p>
3.12.00	<p>PVC water stops (230 mm wide) has to be provided on all junctions of vertical wall of trench with base slab. Similar construction joints shall be provided also in the base slab and vertical wall joints wherever required or as directed by the Engineer-in-Charge. The details of all type of construction joints shall be prepared by Contractor and got approved from the Owner.</p>
3.13.00	<p>All anchors, anchor bolts, insert pipes, conduits, sleeves; bolts etc. and any other item that is required to be embedded in concrete shall be placed in position before concreting. Extra care shall be taken to maintain their position. These inserts shall be welded to the nearest reinforcement to keep them in position.</p>
3.14.00	<p>The fence around switchyard area shall comprise of Saima Chain link (mesh size 75mm) or equivalent to a height of 2.4 m with a 600mm concertina above it such that total fence height is 3.0 m above finished grade level.</p> <p>The chain link will be stretched and attached by 'C' clips at 1/2m intervals to 3 strands of high tensile spring steel wire 12 gauge which in turn are attached to the fence post with security nuts and bolts. On every fourth post, a clamping strip will be threaded through the links of chain link and bolted to the fence post.</p> <p>Above the chain link, a 600 mm HTSW Concertina or equivalent will be stretched to 6m and attached to 4 strand HTS wire by means of 'C' clips at 1 m intervals. The HTS wire strand will be attached to wire brackets with 1/2" security fasteners.</p> <p>All fence post will be 70 x 70 MS angle. All corner post will have two stay posts and every tenth post will have a transverse stay post. Suitable foundations for the angle iron posts and stays shall be provided based on the prevailing soil conditions. All gate shall</p>

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Clause No.	SWITCHYARD CIVIL WORKS
3.15.00	<p>be of hot dipped galvanised structural steel and shall be sturdy with provision of locking.</p> <p>Toe walls of brick masonry with bricks of minimum 50 kg/cm² crushing strength shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200mm above the Switchyard formation level with 50mm thick PCC topping (1:2:4) and shall extend minimum 300mm below the Switchyard Formation level. Toe wall shall be plastered with Cement Sand mortar (1:6) on both sides and shall be painted with two coats of cement paint of approved colour and shade, toe wall shall be provided with weep holes at appropriate spacing.</p> <p>Gates and barriers shall be fabricated out of structural steel angles, channels, joists, flats and plates, etc. The structural steel used for fabrication shall be of mild steel conforming to IS: 226 (latest). The size of gates and barriers shall be as shown on approved drawings and shall be fabricated as per approved drawings. The foundations for gates and barriers shall be of RCC of M20 grade.</p>

Clause No.	CIVIL WORKS
1.00.00	GENERAL
1.01.00	<p>This section covers design, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour, materials and construction of all civil, structural and architectural works for 100MW \pm 20% Tripura Gas Based Combined Cycle Power Project.</p> <p>Description of various items of work and nature of work in brief are given hereinafter. The complete work under this scope is referred to as civil works. The scope of work is also covered in <i>Particular Technical Specification for Civil Works of Vol-III (Module-C1 of Part E "General Technical Specification")</i> and therein shall constitute the scope of work. Irrespective of what is stated in this document all civil works required to complete the entire scope of work specified elsewhere of this bid document shall be deemed to be in the scope of this contract.</p> <p>The work to be performed under this specification consists of Design, Engineering, providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds, temporary labour and staff colony, temporary site offices, constructional plants, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the <i>Particular Technical Specification for Civil Works (Part-E, Vol-III)</i> including revisions and amendments thereto as may be required. In case of discrepancy this specification overrides BIS specification. However, if certain works are not described here, they shall be carried as per latest BIS spec. Any specification mentioned elsewhere of this bid document and considered necessary to complete the entire scope of work shall be deemed to be in the scope of this contract.</p> <p>All materials including cement, reinforcement steel and structural steel etc. shall be provided by the Bidder.</p> <p>The scope shall also include setting up by the Bidder a complete testing up laboratory in the field to carry out all relevant tests required for the civil works for the project.</p> <p>Levelling and grading inside plant boundary shall be done by the bidder. All survey works and other related works shall be done by the bidder.</p> <p>The layout and levels of all structures shall be made by the Bidder at his own cost from the general grid of the plot and the nearest GSI/ plant bench mark or as per the directions of the Engineer-in-charge. The Bidder shall be solely responsible for the correctness of the layout and levels.</p> <p>Bidder shall give all helps to the Engineer-in-Charge in checking correctness of the same by providing instruments, materials, etc.</p> <p>All the quality standards, tolerances, welding standards and other technical requirements as covered in this section shall be strictly adhered to by the Bidder. For those not covered herein, relevant Codal provision shall be followed.</p> <p>The <i>Particular Technical Specification (Volume-III, Part-E)</i> shall be generally followed. In case of any discrepancy between the specification given here as compared to particular technical specification, specification mentioned in this section will supersede.</p> <p>The Bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions and site specific</p>

Clause No.	CIVIL WORKS
	<p>parameters and shall cover for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the section.</p> <p>A general layout plan is enclosed in Vol-V of Tender drawing for reference purpose only and the work shall be carried out according to the layout, design /drawings to be developed by the Bidder and approved by the Employer. For all buildings & structures, facilities, systems, etc., necessary layout and details are to be developed by the Bidder keeping in view the statutory & functional requirements of the plant & facilities providing enough space & access for operation, use and maintenance. Certain minimum requirements are indicated in this section for guidance purpose only. However, the bidder's offer shall cover the complete requirements as per the best prevailing practices and to the complete satisfaction of the Employer, keeping minimum requirement in view.</p>
2.00.00	SUBMISSION
2.01.00	The following documents are to be submitted for the approval of the Employer, prior to commencement of fabrication & erection/construction. All drawings shall be of standard sizes (Metric System) and shall be made on AutoCAD. The contractor shall also submit all the drawings in editable electronic media (AutoCAD Compatible). The list is not exhaustive but indicative only.
2.01.01	General layout plan drawing with coordinates of roads, boundary wall, watchtowers, buildings and facilities, piping/cable corridors, pipe and cable trestles, etc.
2.01.02	Drawing showing underground facilities with co-ordinates of all facilities such as buried pipes, buried cables, trenches, ducts, sewer, drains, sumps, pits, culverts, foundations etc.
2.01.03	Architectural floor plans, elevations, cross-sections of all buildings and prospective view in colour for GT, ST and common control room facility buildings including provision of sufficient natural light for GT, WHRB & ST buildings (Contractor shall submit three different schemes for Owners approval).
2.01.04	A block model of presentation nature of the plant area.
2.01.05	Project design intent document giving the basis of design, which shall cover all the aspects of analysis and design of all the structures, and facilities and their components, details of parameters, assumptions, references, structural idealisation/mathematical model, loading cases/combination and method used for the analysis and design shall be furnished and got approved before the commencement of detailed engineering.
2.01.06	Analysis, & design calculations and drawings for foundations/sub-structure and superstructure of all buildings structures facilities systems, pump houses and other structures.
2.01.07	Analysis, design calculations including dynamic analysis and drawings for all foundations subjected to dynamic loads like foundations for TG, SG etc.

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6.00.00	TOPOGRAPHICAL SURVEYING
6.01.00	Precision Surveying shall be carried out under the direction and control of a Licensed Land Surveyor. Precision theodolites used shall be of one second accuracy. Self-aligning levels shall be used for precision level survey. All Bench Mark (BM) levels of the survey shall be established with reference to the nearest GTS bench mark available. Precision levelling shall be carried out for establishing the BM at site by carrying levels from GTS BM.
6.02.00	Spot levels shall be taken in a grid of five meters (5m) and contours shall be established at an interval of 500mm. All contour levels shall be with respect to MSL.
6.03.00	The survey map should identify all topographical features such as but not limited to buildings, structures, burial grounds, wells, natural drains, roads, footpaths, depressions, rock out crops, underground sources, overhead transmissions lines, telephone lines or any other obstruction, trees and prominent vegetation. In addition, all wet land and marshy stretches shall also be identified. Contractor shall prepare contour map to a scale of 1 in 1000 in AutoCAD. In addition, Contractor shall prepare LS and CS of the site at suitable intervals to adequately represent actual topography. For natural drains and other water courses sections at closer intervals shall be provided. Since the site is situated closer to the river, highest water level occurring once in 50 years shall be clearly marked in the contour plan.
6.04.00	Contractor shall furnish one soft copy in a floppy alongwith twelve (12) copies of all survey drawings to the Owner for his reference.
7.00.00	SITE DEVELOPMENT WORK
7.01.00	<p>Site Clearance</p> <p>The plant and building areas in the site shall be cleared of all trees, shrubs or other vegetation, rubbish, slush etc. and other objectionable matters. If any roots or stumps of trees are met during excavation, they shall also be removed. Where earth fill is intended, the area shall be stripped of all loose/soft patches or top soil containing objectionable matter before filling commences.</p> <p>The contractor shall be deemed to have visited and carefully examined the site and surroundings and to have satisfied himself about the nature of the existing structures, underground services, general site conditions, the site for disposal of surplus materials, debris etc. and all other items affecting the work. Claims due to ignorance of site conditions will not be considered after submission of bid.</p>
7.02.00	Site Grading
7.02.01	Based on the detailed topographical survey conducted at site by the contractor, duly taking into account information included he shall conduct a study on the site grading. The preliminary objective of the study shall be to ensure that the grade level at all important buildings/facilities are kept above the highest flood levels. The observed HFL

Clause No.	CIVIL WORKS
	<p>at river Gomti at Sonamura is 14.63 m.</p> <p>Storm water can be drained by gravity even during normal high water level in the surrounding areas.</p> <p>The minimum grade level of the plant area shall not be less than 1000mm above the highest flood level at the site.</p>
7.02.02	<p>In order to optimise the use of locally available earth, the Contractor may consider terraced grading provided the above two objectives are achieved. Fills shall normally be compacted upto 95% Modified Proctor density. In case earth has to be borrowed from outside the plant boundary, the same shall be arranged by the Contractor himself. Earth from swamps, marshy as well as bogs, expansive type of clays, peat, organic material, material susceptible for combustion, material which will react with other material already used in work shall not be used as borrow material. A minimum side slope of 1 vertical: 2 horizontal shall be maintained at all slopes.</p>
7.02.03	<p>Slopes shall be provided with proper protection to prevent erosion.</p>
8.00.00	MAIN PLANT BUILDING
8.01.00	<p>Main Plant shall comprise of :</p> <p>GT Building</p> <p>WHRB Building</p> <p>ST Building</p> <p>Common Control Room Building</p> <p>All floors shall generally be provided with cast-in situ RCC slab. However, steel grating, chequered flooring as well as pre cast RCC covers shall be provided as per the functional requirements.</p>
9.00.00	STACKS
9.01.00	General
9.01.01	<p>The (HRSG) stacks shall be capable of serving satisfactorily, under all the respective normal and emergency operating conditions to which they may be subjected during the life of plant. The stack and the lining material, if any, shall therefore be selected to serve the worst operating condition.</p>
9.01.02	<p>The stacks shall be provided with access ladders with fall prevention devices using safety belts along with closely spaced circular safety hoops. At least two continuous external platforms with hand railing (one near the top and one near the mid height) shall be provided on each stack.</p>
9.01.03	<p>Thermal insulation for the HRSG stacks shall conform to the requirements.</p>

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15.14.00	One number drain sump along with sludge pit shall be provided.
15.15.00	Single sheet steel door with locking facility of 18G mild steel, hot dip galvanised shall be provided in each fan stack at fan deck level. Minimum door size shall be 2100 mm high (clear) & 1200 mm wide (clear). The galvanisation shall not be less than 610 gm/sq.m on each side as per IS: 4759.
15.16.00	External surface of cooling tower shall be painted with three coats of water proof cement paint of approved colour applied over a coat of primer.
15.17.00	2.5m wide plinth protection shall be provided around CW cooling tower, along outer edge of basin, for easy approach and inspection.
16.00.00	EFFLUENT TREATMENT SYSTEM
	The civil works connected with effluent treatment such as clarifiers, softener tanks, oil separator pits, sumps, centrifuge structures, pumps house structure, pipe supports, valve pits, central monitoring basin etc. are covered under this system. The structures containing liquid shall be designed as water retaining structure as per IS: 3370 and shall be lined with appropriate acid/alkali resistant lining, commensurate with the degree of aggressiveness of the liquid to be retained handled. All effluents shall be carried in separate lined drains and shall be carried by gravity to central monitoring basin. The Engineering of the treatment process shall be done to meet the effluents standards below statutory limits.
17.00.00	SWITCHYARD CIVIL WORK
17.01.00	Scope
17.01.01	The scope shall cover all civil foundation works associated with design, construction, and erection and commissioning of 132 KV Switchyard. Proposed Switchyard layout drawings are enclosed in drawing volume for reference purpose. Switch room building inside the Switchyard area shall be utilised for housing the total control system for the switchyard. The scope shall generally cover, but not limited to following works.
17.01.02	Design, preparation of drawings and construction of civil foundation works for equipment supporting structures, tower, lightning mast and other associated structures including embedment in concrete complete.
17.01.03	Design, preparation of design drawings, supply of materials, inclusive of all fixtures such as nuts, bolts, clamps, step bolts/ladders, Stub, inserts in concrete, foundation bolts, base plates stiffeners, fixtures for supporting and operating mechanism boxes, control cubicles, and any other item required to complete the job.
17.01.04	Supply, fabrication, erection of galvanised steel support structures for cable tray support, steel embedment in cable trenches, bolts and nuts and any other accessories required to complete the job.

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17.01.05	Design, engineering, excavation, dewatering, carriage of excavated earth materials, P.C.C. mud mat, piling, (wherever required), casting of R.C.C. foundation, pile caps, back filling etc. for switchyard structures in accordance with specifications laid down in the tender document.
17.01.06	Construction of R.C.C. cable trenches and pipe trenches with necessary pre-cast R.C.C. covers with lifting facilities, sump pit, wherever trenches cross road or rail tracks, the section below such crossings shall be designed as per Indian road congress and Indian Railways Specifications, as the case may be, suitable drainage of these trenches shall be provided.
17.01.07	All civil works related with laying of Earthing mat in switchyard area as per electrical/switchyard specification.
17.01.08	Entire Drainage of the switchyard area is in Bidder's scope. The cable trench should not be used for drainage purpose.
17.01.09	Suitable system for draining the transformer, oil collection, oil separation pit and disposal system shall be provided.
17.01.10	Grading and metalling in Switchyard area shall be done as per <i>Particular Technical specification for Civil works of Vol-III (Part-E, Section-15 of Module-6, "Common Civil Works")</i> .
17.01.11	All transformer foundations, rail tracks, oil pits, jacking pads, locking arrangements etc including spare Auto transformer & generator transformer foundation and fire protection walls are in bidder's scope.
17.01.12	RCC Roads within switchyard, chain link fencing and gates as per technical specification are also to be provided by bidder.
18.00.00	CORROSION PROTECTION MEASURES
	All structural steel and RCC members/structures shall have to be provided with corrosion protection measure. Especially all the exposed metallic surfaces of the Switchyard, DM Plant, Cooling Tower etc. have to be galvanized.
18.01.01	Structural steel As preventive measure against aggressive atmospheric environment, the corrosion protection measure shall be adopted by the bidder as minimum requirement for all steel structures other than that of switchyard structures. Switchyard steel structures shall be galvanized as specified under the relevant clause of this specification.
18.01.02	RCC Members (Superstructure) The following preventive measures are required to be adopted by the bidder as minimum requirement.

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	<p>For Indoor RCC Members</p> <p>Dense and Durable concrete is to be used</p> <p>Water/cement ratio shall generally be restricted to 0.55. Plasticizer, if required, may be used.</p> <p>For Outdoor (or Exposed) RCC Members</p> <p>Dense and Durable concrete of grade M 25 is to be used.</p> <p>Water/cement Ratio shall be restricted to 0.5. Plasticizer, if required, may be used.</p> <p>Clear cover to reinforcement shall be increased by minimum 15 mm, over and above the values specified for normal conditions in relevant BIS Codes.</p> <p>Two coats of water repellent siliconate based (transparent) paint shall be applied over the final finished surface.</p>
18.02.00	<p>RCC Members (Underground sub-soil condition)</p> <p>Protective measures for underground facilities/structures shall be on the basis of results of detailed chemical analysis of soil and underground water. The following shall be adopted in addition to other protective measures:</p> <p>Water/cement ratio shall be restricted to 0.45.</p> <p>Clear cover to reinforcement shall be minimum 40 mm for thin sections like trenches.</p>
18.03.00	<p>The Bidder shall submit his comprehensive proposal for the corrosion protection measures, based on the type of exposure, nature of structure and type of material, for employer's approval at the time of detailed engineering.</p>
19.00.00	<p>WATER SUPPLY AND SANITATION</p>
19.01.00	<p>Roof water tank of adequate capacity depending on the number of users and 8 hours requirement shall be provided for each building and pump house. Polyethylene water storage tank conforming to IS: 12701 shall be used. The tank shall be complete with all fittings including float valve, stop cock etc.</p>
19.02.00	<p>Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.</p>
19.03.00	<p>Sand Cast Iron pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.</p>
19.04.00	<p>Minimum two toilet (male & female) block with all the facilities shall be provided on each floor of GT & ST, common control room buildings and facility building. Attached toilets shall be provided for all senior executive rooms and conference rooms. One toilet shall be provided in the HRSG area. All other buildings shall have one (male & female) toilet block for each unit on every floor level. The facilities provided in the toilet block shall depend on the number of users. IS: 1172 shall be followed for working out</p>

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20.01.02	Manholes shall be provided at every 30 m along the length, at connection point and at every change of alignment, gradient or diameter of a sewer pipeline
20.02.00	The design, layout, construction, capacity and sizes of septic tank shall be as per technical specification and approved drawings.
20.03.00	The effluent from the septic tank shall be disposed off by soil absorption system as specified in technical specification and as per approved drawings. Tolerance limit for sewage effluents discharged into inland surface water shall be as per IS 4764.
21.00.00	ROADS AND DRAINS
21.01.00	California Bearing Ratio (CBR) shall be followed for the design of roads. A detailed CBR test which is an adhoc penetration test shall be carried out as per the procedure outlined in IS: 2720 (Part XVI). Shoulders with pre-cast concrete blocks (Minimum 100 mm thickness and M20 grade concrete) laid over compacted sub-grade shall be provided on either side of the roads.
21.02.00	All main roads (other than road inside the switchyard) shall be of 10 m wide blacktopping and 2.5 m wide shoulders on either side of the road., maintenance and inspection road and road inside the switchyard, periphery road along boundary wall shall be Single lane roads with 3.75m wide black topping and 1.5 m wide shoulder on either side of the road. However width of the road may vary as per site requirement and as per approved layout. All drains, culverts required for drainage shall also be constructed.
21.03.00	Concrete kerb stones shall be provided on both sides of black topping.
21.04.00	Access roads to all buildings (including buildings to be provided by the Employer) and to areas such as transformer yard, HRSG area and other equipment areas (where access is necessary from inspection, operation & maintenance point of view) shall also be provided by the Bidder.
21.05.00	Finished top (crest) of roads shall be 250mm above the surrounding grade level.
21.06.00	Roads construction shall be as per technical specification and IRC standards. Minimum thickness of black topping (premix carpeting) shall be 25 mm followed by seal coat at the time of execution of works. Before handing over the works to employer premix carpeting shall be 50 mm followed by seal coat. For premix carpet recommendation of IRC-14 shall generally be followed. The materials used in road construction shall meet IRC standards.
21.07.00	In addition to above all roads shall be free from any defect/damage at the time of handing over to the Employer.
21.08.00	In general, all plant effluent drainage shall be through buried concrete pipes and all storm water drainage shall be through open RCC drains/pipe drains. RCC Open or

Clause No.	CIVIL WORKS
	closed storm water drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas etc.
21.09.00	All open surface drains outside the buildings and outside areas of HRSG. Switchyard & transformer yard shall be provided with removable pre-cast RCC perforated covers designed suitably.
21.10.00	All storm water drains shall be connected to the nearest suitable drain for final disposal.
22.00.00	MISCELLANEOUS SPECIFICATIONS
	Expansion joints for all underground structures shall be made water tight by using ribbed PVC water stops with central bulb or of kicker type as per requirement. The thickness and width of PVC water stops shall be as per the requirement of design. However the minimum thickness and width shall be 6mm and 230 mm respectively.
22.01.01	The surplus excavated earth shall be disposed off as directed by the Engineer-in-Charge.
22.01.02	The number of construction joints in the columns of steam turbine foundation shall be restricted. Construction joints at the following three locations shall be provided. At the meeting points of the columns & the raft. At the points of contra flexure in the columns. At the meeting points of column and the top deck. Additional reinforcement & shear keys shall be provided at the construction joints. The base raft for steam turbine & GT foundations and table top of steam turbine shall be cast in single pour.
22.02.00	A screed concrete layer not less than 75 mm thick and of grade not weaker than M15 conforming to IS: 456 shall be provided below all water retaining structures, foundations, trenches, etc. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the creed and the base slab concrete of the water retaining structure.
22.03.00	Doors and Windows
22.03.01	Doors and windows on the external wall of building with metal cladding shall be fixed by creating recesses in the cladding system.
22.03.02	Doors and windows on external brick wall of buildings shall be provided with RCC sunshade over the opening extending 300mm on either side of the opening. Projection of sunshade from the wall shall be minimum 450mm over window openings and 750mm over door openings.
22.04.00	Monorail, monorail girders and fixtures shall be provided, wherever required to facilitate erection/maintenance of equipment.

Clause No.	CIVIL WORKS
22.05.00	All stairs shall have a maximum riser height of 180mm and a minimum tread width of 250mm. Minimum clear width of stair shall be 1200 mm. All ladders shall be of MS angles with MS rungs galvanised to 610 gm/m ² as per IS.
22.06.00	In design of all buildings, including GT & ST Buildings, fire safety requirements conforming to IS: 1641 and IS: 1642 shall be followed in addition to TAC requirements.
22.07.00	Wherever possible all floor openings shall be provided with 100mm thick 150 mm high RCC kerb all around. Angles 50x50x6mm (minimum) with lugs shall provided for edge protection all around cut outs/openings in floor slabs, edges of concrete drains supporting grating/covers, edges of RCC cable/Pipe trenches supporting covers/chequered plates, edges of manholes supporting covers, supporting edges of pre-cast RCC covers and any other place where breakage of corners, of concrete is expected
22.08.00	Drains
22.08.01	All drains inside the building shall have minimum 4 mm thick steel grating covers galvanised to 750 gm/m ² . In areas where heavy equipment loads would be coming, pre-cast RCC covers shall be provided in place of steel grating. All the drains shall be provided with Acid/alkali resistant tiles jointed with acid/alkali resistant cement slurry as per IS: 4457. Bedding, jointing and pointing shall comprise of Furane resin/epoxy resin mortar conforming to IS: 4832 (Part-II). Total thickness of flooring shall be 50mm.
22.08.02	All drains outside building shall have perforated pre-cast RCC covers of minimum 50mm thickness with provision of openable galvanised (910gm/m ²) steel grating cover at about 4.0m interval. In areas where vehicular loads would be coming pre cast RCC covers of suitable thickness without perforations and designed for the vehicular loading shall be provided.
22.09.00	Floor of switchgear room shall be provided with embedded M.S. channel suitable for easy movement of breaker panels.
22.10.00	Anti termite chemical treatment shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS:6313 and other relevant Indian Standards.
22.11.00	Wherever required minimum 900 mm high hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (Medium Class) conforming to IS: 1161 and shall be galvanised as per IS: 4759 and IS: 1239. All rungs and ladder shall also be galvanised.
22.11.01	For RCC stairs, hand railing with 110mm dia stainless steel balustrades with suitable 48mm dia steel top rail, 20mm dia middle rail and 38mm dia intermediate verticals shall be provided.

Clause No.	CIVIL WORKS
22.12.00	In all buildings, suitable arrangement for draining out water collected from room equipment blow down, leakages, floor washings, fire fighting etc. shall be provided for each floor with suitable floor drains & suitable pumping arrangement, if required.
22.13.00	All cable & pipe routing in outlying area shall be clubbed and shall run over ground on steel trestles or other supporting structures at a height of not less than 300 mm above grade for easy inspection & maintenance except in some localised area (as approved by Employer) where the same can run in trenches. In case of trestle min.7.90 m head clearance shall be provided for road crossing. In case cable route is not envisaged in the area, pipe shall be routed on ground over RCC pedestals at a height of not less than 500 mm. All trenches (wherever specified) shall be of RCC with min M-25 grade with removable RCC covers. No cable trenches/ground cable vaults shall be acceptable in STG hall and HRSG area.
22.13.01	Cable Trenches located outside the buildings such as switchyard area and transformer yard areas shall project atleast 200 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of the trench shall be provided with a slope of 1:500 for draining out the collected water into a outlet drain. The pre cast covers shall not be more than 300 mm in width. Lifting hooks shall be provided in the pre cast covers. The trenches shall be given a slope of 1 in 200 in the direction perpendicular to the run of the trenches. PVC water stops shall be provided at all expansion joints of all trenches. The trenches shall be provided with cable supporting arrangement on both sides at regular intervals to take care segregation of power control cables, and density of cables of each tier.
22.14.00	All steel platforms above grade shall be provided with kick plates at edge of platform to prevent tools or materials from falling off platform.
22.15.00	RCC staircase shall be provided for main entrance adjacent to central Control Room Building and all other RCC construction buildings.
22.16.00	Duct banks consisting of PVC conduits for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.
22.17.00	Independent network of lines for sewerage and drainage shall be provided. No plant effluent shall be mixed with storm water/sewage.
22.18.00	Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC. However, the sub-grade for the embankment filling shall be compacted to minimum 95% of the Standard proctor density at Optimum moisture content (OMC)
22.19.00	Detailed scheme for dewatering shall be prepared/ approved before starting of deep excavation work.
22.20.00	All underground concrete structures like trenches, substructures, of pump houses, all water retaining/carrying structures etc. shall have plasticizer cum water proofing

Clause No.	CIVIL WORKS																		
10262.	<p>Minimum grade of concrete for various structures/areas other than machine foundations shall be as follows unless noted otherwise (UNO):</p> <p>M20- For super structural RCC works including RCC pavings.</p> <p>M25-For underground/sub-structural RCC works.</p> <p>Minimum cement content shall be as per Codal provision UNO and strength requirement shall be as per IS 456.</p> <p>The grades of concrete for different machine foundations shall be as follows:</p> <table><tr><th>Sl. No.</th><th>Description</th><th>Minimum grade of concrete</th></tr><tr><td></td><td>STG Top Deck</td><td>: M-30</td></tr><tr><td></td><td>Sub structure supporting STG (columns & beams, base raft)</td><td>: M-25</td></tr><tr><td></td><td>GT foundation</td><td>: M-30</td></tr><tr><td></td><td>BFP foundation</td><td>: M-25</td></tr><tr><td></td><td>All other machine foundations</td><td>: M-25</td></tr></table> <p>Higher grade of concrete than specified above may be used at the discretion of the Bidder.</p> <p>Unless specified 20mm and down aggregates shall be used for all structural concrete works.</p> <p>Special requirements for concreting of major equipment foundations shall be as given below.</p> <p>Temperature Control of Concrete</p> <p>The temperature of fresh concrete shall not exceed 35 deg. Centigrade when placed. For maintaining the temperature of 35 deg. Centigrade in the top deck of machine foundations, crushed ice shall be used in mixing water.</p> <p>Admixture</p> <p>Plasticizer-cum retarder type admixture shall generally be added to the concrete for promoting workability in addition to retarding setting time, for</p>	Sl. No.	Description	Minimum grade of concrete		STG Top Deck	: M-30		Sub structure supporting STG (columns & beams, base raft)	: M-25		GT foundation	: M-30		BFP foundation	: M-25		All other machine foundations	: M-25
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	<p>mass concreting work. The slump shall generally be in the range given below:</p> <table><tr><td>STG Top deck</td><td>-</td><td>150mm to 200mm</td></tr><tr><td>Block foundation</td><td>-</td><td>100mm to 150mm</td></tr><tr><td>Column</td><td>-</td><td>100mm to 150mm</td></tr></table> <p>Form work</p> <p>Plywood formwork shall be used for the top decks of all machine foundations and also for columns of STG foundation.</p> <p>Scheme for Concreting</p> <p>Weight Batching Plants shall be mobilised for all machine foundations. Concrete pump shall be mobilised for STG raft, STG Top Deck. Arrangements for stand-by Plant and Equipment shall also be made</p> <p>Placing of Concrete</p> <p>Base Raft and top deck of machine Foundations shall be cast in a single pour.</p> <p>Ultrasonic Testing</p> <p>Ultrasonic pulse velocity test shall be carried out for the Top Decks of all machine foundations and TG substructure to ascertain the homogeneity and integrity of concrete. In addition cubes (at the rate of one cube per 120 cum. of concrete subject to a minimum of six cubes) shall be taken to carry out Ultrasonic Pulse velocity (UPV) testing, to serve as reference UPV values.</p> <p>Testing shall be done as per IS: 1331 (Part-1). In case of any defects, the Bidder shall rectify the defects suitably using cement/epoxy grout etc.</p>	STG Top deck	-	150mm to 200mm	Block foundation	-	100mm to 150mm	Column	-	100mm to 150mm
STG Top deck	-	150mm to 200mm								
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22.32.00	2m wide pathway with concrete chequered tiles 22mm thick laid over minimum 100 mm thick PCC bedding as per IS:13801 shall be provided to all operating valves of fire fighting system. Also the area below over ground pipes/cable trays shall be paved to avoid weed growth. The width of paving shall be upto 0.5m beyond the width of supporting structure on both sides. The paving shall be with pre cast concrete tiles (M20 grade) minimum 100mm thick laid over compacted sub grade.									
23.00.00	FINISHING SCHEDULE									
23.01.00	Flooring <p>The nominal total thickness of floor finish shall be 50mm including under bed and topping. The flooring shall be laid on already matured concrete base. The under bed for floors shall consist of cement concrete 1:2:4 with stone chips 12.5mm down graded as coarse aggregates. The under bed shall be provided with appropriate slope towards catch pit for floor drainage.</p>									

Clause No.	CIVIL WORKS		
	The ceiling shall comprise of modules of size 600mm x 600mm x 14mm unless otherwise specified. The system will be random fissured with 3 coat of white paint and backside will be sanded with one coat of paint.		
24.00.00	PERMISSIBLE TOLERANCES FOR CIVIL WORKS		
24.01.00	Cast-in-situ concrete works		
	Description of Items/ Structural element	Permissible Deviation in mm	
	The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerances given below in mm.		
	Faces of concrete in foundations and structural members against which back fill is placed	+ 25	- 10
	Location of footing (for RCC framed structures only)	+ 25	- 25
	Eccentricity of footing	2% of footing width in direction of misplacement but limiting to 50 mm.	
	Top surfaces of slabs and of concrete to receive base plates to be grouted.	+ 5	- 5
	Alignments of beams, lintels, columns, walls, slabs, and similar structural elements	+ 5	- 5
	Description of Items/ Structural element	Permissible Deviation in mm	Description of Items/ Structural element
	Cross sectional dimensions of walls, slabs and similar structural elements	+ 5	- 5
	Deviation from specified dimensions of cross-section of columns and beams.	+ 12	- 6
	Alignment of holding down bolts without sleeves.	+ 1.5	- 1.5
	Alignment of holding down bolts with sleeves.	+ 5	- 5
	Level of holding down bolt assemblies.	+ 10	- 10
	Embedded parts (in any direction).	+ 5	- 5

Clause No.	CIVIL WORKS
	<p>Centres of pockets or holes with greatest lateral dimension not exceeding 105mm. + 10 - 10</p> <p>Variation in steps:</p> <p>Riser + 1.5 - 1.5</p> <p>Tread + 3.0 - 3.0</p> <p>Plumb 3mm for every metre subject to a maximum of 10mm.</p>
24.02.00	<p>Form work</p> <p>Levels and heights $\pm 6\text{mm}$</p> <p>Plumb 3mm for metre subject to maximum of 10mm.</p> <p>Finishing tolerance in slabs</p> <p>Trowel finish 3 mm for 3m.</p> <p>Broom /floated finish 6mm for 3 m.</p> <p>Unevenness of any surfaces $\pm 3\text{mm}$</p> <p>Length or breath $\pm 12\text{mm}$</p> <p>Diagonals $\pm 15\text{mm}$</p> <p>In case of inclined surfaces like folded plates etc. The deviation in the alignment of inclined surfaces, shall not exceed 3 mm with reference to the theoretical alignment, for a length of 1000 mm measured vertically, subject to a maximum of 10 mm.</p>
24.03.00	<p>Masonry</p> <p>All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpend properly aligned.</p> <p>Deviation in verticality in total height of any wall of a building more than one storey in height shall not exceed +12.5mm.</p> <p>Deviation from vertical within a storey shall not exceed +6mm per 3m height.</p> <p>Deviation from the position shown on the plan of any brickwork more than one storey in height shall not exceed 12.5mm.</p> <p>Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment shall not exceed 6mm.</p>

Clause No.	CIVIL WORKS																		
	<p>Deviation of bed joint from horizontal in any length upto 12m shall not exceed 6mm, and length over 12m it shall not exceed 12.5mm total.</p> <p>Deviation from the specified thickness of bed-joints, cross joints or perpends shall not exceed+3mm.</p>																		
24.04.00	<p>Plastering work</p> <p>The finished plastered surface shall not show any deviation more than 4mm when checked with a straight edge of 2 metre length placed against the surface.</p> <p>The thickness of the plaster shall be measured exclusive of the thickness of key i.e. grooves or open joints in brickwork. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3mm for plaster thickness above 12mm and 1mm for ceiling plaster. Extra thickness required in dubbing behind rounding of the corners at junctions of wall or in plastering of masonry cornices etc. shall be ignored.</p>																		
24.05.00	<p>Pre-cast concrete work</p> <p>Length: +0.1 percent subject to minimum of –5 mm and maximum of +10 mm.</p> <p>Cross-sectional dimensions: +3 mm or +0.1 per cent whichever is greater.</p> <p>Straightness of Bow: 1/750 of the length subject to minimum of –5mm and maximum of +10mm.</p> <p>Squareness: when considering the squareness of the corner, the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5mm.</p> <p>Flatness: The maximum deviation from a 1.5m straight edge placed in any position on a nominal plane surface shall not exceed 5mm.</p>																		
24.06.00	<p>Reinforcement work</p> <p>Cast-in-situ concrete works</p> <table><tr><th>Description of Items/ Structural element</th><th colspan="2">Permissible Deviation in mm</th></tr><tr><td colspan="3">Placing of reinforcement</td></tr><tr><td>For effective depth 200 mm or less</td><td>+ 25</td><td>- 25</td></tr><tr><td>For effective depth more than 200 mm</td><td>+ 15</td><td>- 10</td></tr><tr><td>Cover to reinforcement</td><td>-</td><td>- 5</td></tr><tr><td colspan="3">Cutting of reinforcement</td></tr></table>	Description of Items/ Structural element	Permissible Deviation in mm		Placing of reinforcement			For effective depth 200 mm or less	+ 25	- 25	For effective depth more than 200 mm	+ 15	- 10	Cover to reinforcement	-	- 5	Cutting of reinforcement		
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Clause No.	CIVIL WORKS		
	When maximum or minimum length	+ 75	-
	When maximum or minimum length not specified.	+ 75	- 25
24.07.00	Tolerance in erected CW liners/ pipes		
24.07.01	At setting out points	:	± 25 mm in position & level
	Between setting out point	:	± 50 mm in position & level
24.07.02	Flanges for condenser	:	± 6 mm in position & level connections and the plane of the flanges shall be within 3mm of the required plane measured across and diameter.
24.07.03	Other terminal points	:	± 6 mm in position & level and the plane of the flange shall be within 0.3% of the dia or 1mm whichever is greater, of the required plane measured across and diameter.
24.08.00	The leakage from stop logs/ gates measured should not be more than 5 lits/minute/ meter of length of seal under max. head.		
24.09.00	Structural steel work		
24.09.01	Tolerances on dimensions for fabrication of steel structures shall be according to IS: 7215		
24.09.02	Tolerances on dimensions for erection of steel structures shall be according to IS: 12843.		
24.09.03	Tests on welds shall be as per ASTM standards/IS 816 and IS: 823.		
24.10.00	Dimensional and weight tolerance of rolled steel shapes shall be as per IS: 1852.		
24.11.00	Maximum deviation of finished pile from vertical shall be 1 in 75 and other tolerance shall be as per IS: 2911, Part 1.		
25.00.00	STATUTORY REQUIREMENTS		
25.01.00	Bidder shall comply with all the applicable statutory rules pertaining to Factories Act (as applicable for the state of Tripura), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control, Explosives Act, Environment Protection Act, etc.		

Clause No.	CIVIL WORKS
25.02.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway minimum 500mm wide along the crane-girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, ,locker room for workmen, pantry toilets, rest room etc.
25.03.00	Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tariff Advisory committee.
25.04.00	Statutory clearances and norms of State Pollution Control Board shall be followed.
25.05.00	Bidder shall obtain approval of Civil/ Architectural drawings from concerned authorities before taking up the construction work.
26.00.00	<p>CONSTRUCTION FACILITIES</p> <p>The following are the scope of work for the construction facilities for the project:</p> <p>Roads</p> <p>I. The site is well accessible by road. The contractor shall develop suitable access to various work fronts for transporting the equipment to the respective foundation at his own cost. Roads within the plant boundary including peripheral road along boundary wall shall be constructed by the Bidder.</p> <p>II. Site Development</p> <p>Levelling and Grading inside plant boundary shall be done by the contractor. Plinth level of all the buildings shall be kept at least 0.5 m above formation level.</p> <p>Development of labour colony and bidder's staff colony along with fencing etc. shall also be done by the Bidder.</p> <p>III. Construction Water</p> <p>The construction water required for carrying out the works under the contract shall be arranged by the contractor at his cost. The Contractor shall use ground water by boring required number of tube wells. However, while selecting the tube wells, the Contractor will obtain owner's prior consent. The Contractor shall submit necessary test certificate to the owner to establish suitability of water for civil construction purpose. Owner shall not be responsible in case of breakdown/non-availability of Grid Power.</p> <p>IV. Construction Power</p> <p>Refer specification of Electrical (Vol. II, Part-B).</p> <p>V. Construction Office, Store, workshop and field lab</p> <p>Bidder shall make his own arrangement for the following facilities:</p> <p>Construction Office.</p> <p>Construction store (open/covered), fencing and construction workshop and</p>

Clause No.	CIVIL WORKS
	<p>material/field testing laboratory.</p> <p>Construction store and workshop along with fencing, gates etc. shall be handed over to Owner (NEEPCO) on completion of work.</p> <p>Construction equipment.</p> <p>These shall be procured by Bidder from local sources as far as possible & available in this country and required for timely and quality construction of civil and structural works.</p> <p>VI. Bidder shall make his own arrangement for the stay of his staff at project site with all necessary facilities as per applicable Indian laws.</p> <p>VII. Construction fire fighting</p> <p>Bidder shall provide all the construction fire-fighting devices/equipment.</p> <p>VIII. Construction materials</p> <p>Cement, fine and coarse aggregate, reinforcement steel (mild steel and high yield strength cold deformed bars, structural steel) procured from reputed companies like SAIL, TISCO or equivalent and all other building materials etc. shall be arranged by the bidder.</p> <p>Practically in Tripura no quality stone is available for use as concrete aggregates. Contractor will be required to bring stone aggregate from Haflong and other localities of Assam which is about 500 Km away from project site.</p> <p>Labour</p> <p>Bidder shall arrange skilled/semi-skilled/un-skilled labour from local sources as far as available in this country and supervisory staff for quality execution of all civil and structural works.</p>
27.00.00	<p>INSPECTION, TESTING AND QUALITY CONTROL FOR CIVIL WORKS</p> <p>Sampling and testing for major items of civil works viz. earthquake, concreting, structural steel work (including welding), piling etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified, relevant Indian Standards shall be followed. In absence of Indian Standard, equivalent International Standards may be used.</p> <p>A fully equipped quality control laboratory shall be established at site with qualified personnel to conduct acceptance test on all construction material, weldments, concrete cubes etc. This laboratory shall be housed in a covered building with A/C facility as required by the testing facility. All testing equipment shall be procured by the Contractor and they shall be periodically calibrated to the satisfaction of the Owner. The laboratory building and equipments shall be handed over to NEEPCO on completion of work.</p> <p>The bidder shall submit for employer's approval a detailed field quality assurance programme for civil works before starting of the construction work. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, field quality plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer-in-</p>

Clause No.	CIVIL WORKS
	<p>Charge and the bidder shall submit to the Engineer-in-Charge, the test results in triplicate. In addition, the bidder shall furnish the original test certificate from the manufacturer's of various materials to be used in the construction.</p>
28.00.00	LIST OF CODES AND STANDARD FOR CIVIL WORKS
28.01.00	<p>The contractor shall follow the latest Indian standard Codes as applicable for the design of various works. Some of the applicable Standards, Codes and reference are as follows:</p> <p>Excavating and Filling</p> <p>IS:2720 (part-2, 25) : Methods of tests for soils.</p> <p>IS:4701 : Code of practice for earth work on canals.</p> <p>IS:10379 : Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.</p>
28.02.00	<p>Properties, Storage and Handling of Common Building Materials</p> <p>IS:269 : 33 grade for ordinary Portland cement.</p> <p>IS:383 : Coarse and fine aggregates from natural sources for concrete.</p> <p>IS:432 (Part 1&2) : Specification for mild steel and medium tensile steel bars and hard drawn steel wires for concrete reinforcement.</p> <p>IS:455 : Portland slag cement.</p> <p>IS:456 : Code for practice for plain and reinforcement concrete.</p> <p>IS:702 : Industrial bitumen.</p> <p>IS:808 : Industrial bitumen.</p> <p>IS:712 : Specification for building limes.</p> <p>IS:1077 : Common burnt clay building bricks.</p> <p>IS:1161 : Steel tubes for structural purposes.</p> <p>IS:1366 (Part 1-3) : Hexagon head bolts, screw and nuts of productions grade C.</p>

Clause No.	CIVIL WORKS
IS:1364 (Part1-5)	: Hexagon head bolts, screws and nuts of production grade A & B.
IS:1367 (Part1-18)	: Technical supply condition for threaded steel fasteners.
IS:1489	: Portland-Pozzolana cement.
(Part I)	: Fly ash based.
(Part II)	: Calcined clay based.
IS:1542	: Sand for Plaster.
IS:2185 (Part I)	: Hollow & solid concrete blocks.
(Part-II)	: Hollow & solid light weight concrete blocks.
IS:2116	: Sand for masonry mortars.
IS:2502	: Code of practice for bending and fixing of bars for concrete reinforcement.
IS:2505	: Concrete vibrators-immersion type.
IS:2506	: General requirements for screed board concrete vibrators.
IS:2514	: Concrete vibrating tables.
IS:1566	: Hard drawn steel wire fabric for concrete reinforcement.
IS:1786	: High strength deformed steel bars 7 wires for concrete reinforcement.
IS:2645	: Integral cement water proofing compounds.
IS:2722	: Portland swing weight batchers for concrete (single and double bucket type).
IS:2750	: Steel scaffoldings.
IS:2751	: Recommended practice for welding of mild steel plate and deformed bars for reinforced construction.
IS:3025	: Methods of sampling and test for water and waste water

Clause No.	CIVIL WORKS
IS:3366	: Specification for Pan vibrations.
IS:3370	: Code of practice for concrete.
(Part 1 to 4)	: Structures for the storage of liquids.
IS:3414	: Code of practice for design and installation of joints in buildings.
IS:3550	: Methods of test for routine control for water used in industry
IS:3558	: Code of practice for used of immersion vibrators for consolidating concrete.
IS:4014	: Code of practice for steel tubular.
(Part 1&2)	: Scaffolding.
IS:4326	: Code of practice for earthquake resistant design and construction buildings.
IS:4461	: Code of practice for joints if surface hydro-electric power stations.
IS:4656	: Form vibrators for concrete.
IS:4925	: Concrete batching and mixing plant.
IS:4990	: Plywood for concrete shuttering work.
IS:5256	: Code of practice for sealing expansion joints in concrete lining on canals.
IS:5525	: Recommendations for detailing of reinforcement in reinforcement concrete works.
IS:5624	: Foundation bolts.
IS:6494	: Code of practice for water proofing of under ground water reservoir and swimming pools.
IS:6509	: Code of practice for installation of joints in concrete pavements.
IS:7861 (Part 1 &2)	: Code of practice for extreme weather concreting.

Clause No.	CIVIL WORKS
IS:9012	: Recommended practice for Shotcreting.
IS:9103	: Admixtures for concrete.
IS:9417	: Recommendations for welding cold worked bars for reinforced concrete construction.
IS:10262	: Recommended guidelines for concrete mix design.
IS:11384	: Code of practice for composite construction in structural steel and concrete.
IS:11504	: Criteria for structural design of reinforced concrete natural draught cooling towers.
IS:12118	: Two parts poly sulphide based sealants.
IS:12200	: Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams.
IS:13311	: Non-destructive testing of concrete-methods of test.
Part-1	: Ultrasonic pulse velocity.
Part-2	: Rebound hammer.
SP-23	: Handbook of concrete mixes.
SP-24	: Explanatory Handbook on Indian Standard code for plain Reinforce concrete (IS: 456-1978).
PS-34	: Handbook on concrete reinforcement and detailing.
28.03.00	Pre-cast Concrete Works
SP:7	: National Building Code-Structural
(Part6/Sec.7)	: Design of prefabrication and system building.
IS:10297	: Code of practice for design and construction of floor and roofs using pre-cast reinforced/pre-stressed concrete ribbed or cored slab units.
IS:10505	: Code of practice for construction of floors and roofs using pre-cast reinforced concrete waffle units.

Clause No.	CIVIL WORKS	
	IS:2250	: Code of practice for preparation and use of masonry mortars.
	SP:20	: Explanatory Handbook on masonry code.
28.04.00	Masonry & Allied Works	
	IS:1905	: Code of practice for structural use of unreinforced masonry.
	IS:2212	: Code of practice for brick work.
28.05.00	Sheeting Works	
	IS:277	: Galvanised steel sheets (Plant & corrugated).
	IS:459	: Corrugated and semi-corrugated asbestos cement sheets.
	IS:513	: Cold-rolled low carbon steel sheets & strips.
	IS:730	: Hook bolts for corrugated sheet roofing.
	IS:2527	: Code of practice for fixing rain water gutters and down pipe for roof drainage.
	IS:5913	: Methods of test for asbestos cement products.
	IS:8183	: Bonded mineral wool.
	IS:8869	: Washers for corrugated sheet roofing.
	IS:12866	: Plastic translucent sheet made from thermosetting polyester resin (glass fibre reinforced.)
	IS:12446	: Continuously pre-painted galvanised steel sheets and coils.
28.06.00	Fabrication and Erection of Structural Steel Work	
	IS:2016	: Plain washers.
	IS:2062	Structural steel
	IS:814	: Covered electrodes for manual metal arc welding of

Clause No.	CIVIL WORKS
	<p>IS:2595 : Code of practice for Radiographic testing.</p> <p>IS:1182 : Recommended practice for Radiographic examination of fusion welded butt joints in steel plates.</p> <p>IS:3664 : Code of practice for sonic pulse echo testing contact and immersion method.</p> <p>IS:3613 : Acceptance tests for wire flux combination for submerged arc welding.</p> <p>IS:3658 : Code of practice for liquid penetrant flaw detection.</p> <p>IS:5334 : Code of practice for magnetic particle flaw detection of welds.</p> <p>ACI-318 : American concrete institute code for structural concrete .</p> <p>SP-16 : Design Codes for reinforced concrete to IS:456-1978.</p>
28.07.00	Plastering and Allied Works
	<p>IS:1635 : Code of practice for field slaking of building lime and preparation of putty.</p> <p>IS:1661 : Code of practice for application of cement and cement lime plaster finishes.</p> <p>IS:2333 : Plaster-of-paris for ceramic industry.</p> <p>IS:2404 : Code of practice for external rendered finishes.</p> <p>IS:2547 (Parts1&2) : Gypsum building plaster.</p> <p>IS:3150 : Hexagonal wire netting for general purpose.</p>
28.08.00	Acid and Alkali Resistant Lining
	<p>IS:158 : Ready mixed paint, brushing, bituminous, black lead free, acid, alkali & heat resisting.</p> <p>IS:412 : Expanded metal steel sheets for general purpose.</p> <p>IS:4441 : Code of practice for use of silica type chemical resistant mortars.</p>

Clause No.	CIVIL WORKS
	<p>IS:3462 : Specification for un-backed flexible PVC flooring.</p> <p>IS:4971 : Recommendations for selection of Industrial floor finishes.</p> <p>IS:5318 : Code of practice for laying of flexible PVC sheet and tile flooring.,</p> <p>IS:8042 : White Portland cement.</p> <p>IS:13801 : Chequered cement concrete tiles.</p>
28.13.00	Painting and Allied works
	<p>IS:162 : Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required</p> <p>IS:428 : Distemper, oil, emulsion, colour as required.</p> <p>IS:1477 : Code of practice for painting of ferrous metals in buildings.</p> <p>Part-1 : Pre-treatment.</p> <p>Part-2 : Painting.</p> <p>IS:1650 : Specification for colours for building and decorative materials.</p> <p>IS:2047 : Ready mixed paint, air drying,, red oxide-zinc chrome, priming.</p> <p>IS:2338 : Code of practice for finishing of wood and wood based materials.</p> <p>Part-1 : Operations and Workmanship.</p> <p>Part-2 : Schedule.</p> <p>IS:2395 : Code of practice for painting concrete, masonry and plaster surfaces.</p> <p>Part-1 : Operations and Workmanship</p> <p>Part-2 : Schedule.</p>

Clause No.	CIVIL WORKS	
	IS:2524	: Code of practice for painting of nonferrous metals in buildings.
	Part-1	: Pre-treatment
	Part-2	: Painting.
	IS:2932	: Enamel, synthetic, exterior, (a) under coating and (b) finishing.
	IS:2933	: Enamel exterior, (a) under coating, (b) finishing.
	IS:4759	: Hot dip zinc coatings on structural steel and other allied products.
	IS:5410	: Specification for cement paint.
	IS:5411	: Plastic emulsion paint.
	Part-2	: Paint for exterior use.
	IS:6278	: Code of practice for white washing and colour washing.
28.14.00	Pilling and Foundation	
	IS:1080	: Code of practice for design and construction of shallow foundations on soils.
	IS:1904	: Code of practice for design and construction of foundation in soils : General Requirements.
	IS:2131	: Method of Standard Penetration Test for soils.
	IS:2911	: Code of practice for designs and construction of pile foundations (Relevant Parts).
	IS:2950 (Part-1)	: Code of practice for designs and construction of Raft foundation.
	IS:2974(Part1 to 5)	: Code of practice for design and construction of machine foundations.
	IS:6403	: Code of practice for determination of Bearing capacity of Shallow foundations.
	IS:8009	: Code of practice for calculation of settlement of

Clause No.	CIVIL WORKS
	foundation.
Part-1	: Shallow foundations.
Part-2	: Deep foundations.
DIN:4024	: Flexible supporting structures for machine with rotating machines.
VIN:2056	: Criteria for assessing mechanical vibrations of machines.
VDI:2060	: Criteria for assessing rotating imbalances in machines.
28.15.00	Chimney
IS:2309	: Practice for protection of buildings & allied structures against lightning.
IS:4998 (Part-1)	: Criteria for design of reinforced chimneys.
IS:6533	: Code of practice for design and construction of steel chimneys.
ICAO	: International Civil Aviation Organisation (ICAO).
DGCA	: Instructions of Director General of Civil Aviation, India.
ACI:307	: Specification for the design and construction of reinforced concrete chimneys.
BS:4076	: Specification for steel chimneys.
CICIND	: Model code for concrete chimneys. Model code for steel chimneys.
ASCE	: Design and construction of steel chimney liners prepared by Task committee of steel chimney liners. Fossil power committee, power division published by ASCE-1975
28.16.00	Stop Log and Trash Rack
IS:4622	: Fixed-wheel gates structural design structural design recommendation.
IS:5620	: Recommendations for structural design criteria for low

Clause No.	CIVIL WORKS
	head slide gates.
IS:11388	: Recommendations for design of trash racks for intakes.
IS:11855	: General requirements for rubber seals for hydraulic gates.
28.17.00	Roads
IRC:5	: Standard specifications and Code of practice for road bridges, section-1 General Features of Design.
IRC:14	: Recommended practice for 2cm thick bitumen and tar carpets.
IRC:16	: Specification for priming of base course with bituminous primers.
IRC:19	: Standard specifications and Code of practice for water bound macadam.
IRC:21	: Standard specifications and Code of practice for road bridges, section-111 Cement concrete (plain and reinforced).
IRC:34	: Recommendations for road construction in water logged areas.
IRC:36	: Recommended practice for the construction of earth embankments for road works.
IRC:37	: Guidelines for the Design of flexible pavements.
IRC:56	: Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	: Geometric Design standards for rural (non-urban) highways.
IRC:86	: Geometric Design standards for urban roads in plains.
IRC:SP:13	: Guidelines for the design of small bridges & culverts.
IRC- Publication	: Ministry of Surface Transport (Road wing), specifications for road and bridge works.
IS:73	: Paving bitumen.