TECHNICAL & MATERIAL SPECIFICATIONS

GENERAL INFORMATION

A. **GENERAL**: The work under this tender shall be executed strictly in accordance with constructional and material requirements defined under these specifications. The Contractor shall carefully acquaint himself with these specifications to determine his contractual obligations for the work. The conditions of these specifications will be binding on the Contractor and no deviation shall be permissible unless specifically approved by the Consultant / Project-in-charge in writing. In absence of any detailed Specifications these specification, latest Indian Standard specifications and code of practice shall be come applicable. Wherever the codes and specifications are silent then the same shall be governed by sound engineering practices and the decision of the Project-in-charge / consultant in matters of interpretation etc., shall be final and binding on the Contractor.

B. DRAWINGS / DIMENSIONS:

Figured dimensions on drawings shall supersede measurements by scale and drawings to a large scale take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall be checked on site. Measurements and other information concerning the existing site on the drawings are believed to be correct, but theContractorshallverify them for himself and also examine the nature of the ground as no claim or allowance whatsoever shall be entertained hereinafter on account of any errors or omissions in the levels or the description of the ground turning out to be different from what was expected or shown on thedrawings.

C. CORRELATION OFDRAWING:

Before commencement of work, the Contractor shall correlate all relevant structural, Construction and services drawings and satisfy himself that the information available is complete and unambiguous. The Contractor shall be responsible for any error / difficulty in execution / damage incurred owing to any discrepancy in the drawings which has been overlooked by him and has not been brought to the notice of the Project-in-charge / Consultant beforeexecution.

D. B.I.S CODES OFPRACTICE:

Wherever any reference is made in the specifications to **any bureau of Indian Standard (IS)** code of practice, it shall be understood to indicate the latest version of the code of practice in usage at the time of construction.

E. ALL SIMILARITEMSTOHAVESAMEQUOTEDRATE

It shall be noted by the bidder that a similar item repeated at various sub heads of the tender, he should quote same rates. For any reasons different rates are quoted the lowest rate shall be considered for deriving the substituted / extra item rate if required.

SPECIFICATIONS

1. SPECIFICATIONS FOR EXCAVATION ANDEARTHWORK

1.1 SCOPE

The scope of work broadly includes but is not necessarily limited to the following i.e., clearing of the site, excavation of foundation trenches, back-filling, disposal of surplus earth as required including dewatering, shoring and strutting. Contractor shall provide all tools, labour, equipment and incidentals necessary, required for completion of all aspects of work covered in these specifications.

1.2 TYPES OFSOIL

Contractor shall thoroughly acquaint himself with the types of soil in excavation by an inspection of nature of the ground at site & scrutiny of the investigation details available with the Consultant.

1.3 CLEARING THESITE

The site on which the structure is to be built shown on the drawing and the area required for setting out and other operations like road, drains, sheds, etc. should be cleared and all obstructions, loose stones, materials, and rubbish of all kinds, stump, brush wood and trees removed as directed, roots being entirely grubbed up. All useful materials obtained will be the property of the Project-in-charges and will be handed over to the Consultant. Rejected materials will be removed by the contractor to his owndump.

1.4 GROUND LEVELS AND SITE LEVELPLAN

Before starting the excavations, the requisite block levels of the entire plot shall be taken by the contractor in consultation with the Consultant and a proper record of these levels to be kept, which shall be jointly signed by the Contractor and the Consultant. A block level plan showing-all the ground levels of the plot shall be prepared and shall jointly be signed by the Consultant/Project-incharge.

1.5 SETTINGOUT

After clearing the site, and preparing the site level plan, the Contractor will set out the center lines of the building or other involved works and get the same approved from the Consultant. It shall be the responsibility of the Contractor to install substantial reference marks; bench marks etc. and maintain them as long as required by the Consultant. The Contractor will assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of thework

1.6 EXCAVATIONANDPREPARATIONOFFOUNDATIONSFORCONCRETING

1.6.1 General Foundation trenches shall be dug wet or dry to the dimensions as shown on the drawings or as directed by the Consultant. The excavated materials shall be stacked at a sufficient distance away from the edge of the excavated pit so as not to endanger the stability of the sides. The soil heap shall not exceed more than 2 m from theground.

The contractor shall, at his expense and without any extra charge, make provision for all shoring and strutting, extra excavation in slope, extra excavation in working space, dredging or bailing out water, and the excavation shall be kept free from water when the foundation work is inprogress.

If excavation is carried out to greater width, length or depth than specified, extra depth shall be made up by filling in lean concrete and extra length or width by filling in with earth rammed hard or by masonry as shall be borne in full by thecontractor.

If required to protect the sides of pits and trenches, timber shoring and strutting shall be erected. The timbering shall be closed or open depending on the nature of the soil and work, and arrangement of timbering including sizes and spacing of members used shall be as approved by the Consultant. NO extra charges shall be admissible on thisaccount.

The bottoms of all excavation shall be trimmed and leveled in accordance with drawings / directions of the Consultant / Project-in-charge. The bottoms of all excavation shall be rammed and wetted before deposition of concrete. The contractors shall report to the Consultant / Project-in-charge when the excavation is ready to receive concrete. NO concrete shall be placed in foundations until the contractor has obtained the approval of Consultant / Project-in-charge.

1.6.2 PROTECTION

All foundation trenches and similar excavations shall be strong, fenced and marked with red lights at night for watchmen to avoid accidents. Adequate protective measures shall be taken to see that the excavation does not affect or damage adjoining structures. All measures required for the safety of the excavation, the people working in and near the foundation trenches, property and the people in the vicinity shall be taken care by the Contractor at his own cost, being entirely responsible for any injury and damage to property caused by his negligence or accident due to his construction operations.

1.6.3 STACKING OF EXCAVATEDMATERIALS:

Work for excavation shall include sorting out of useful materials and stacking them on site as directed. Materials suitable and useful for back-filling, plinth, filling, leveling of the plot or other use shall be stacked at convenient places, but not in such a way as to obstruct free movement of men, equipment and vehicles or encroach on the area required for constructional purposes.

1.7 BACKFILLING

1.7.1 Earth obtained from excavation (or approved earth brought from outside for which no extra payment shall be made) shall be filled in layers as described in 1.7.3 around the foundations and under floors, incase extra earth used for filling is required under floors, plinth protection including sit outs, courtyards, the contractor will do at their own cost. The lump sum offer shall be deemed to include the earth filing required under floors and plinth protection with plinth height shown in Drawing above the bottom of foundation concrete and finishedcourtyardlevelshowninDrawingbelowD PC/copinglevelofthemainbuilding.

1.7.2 QUALITY OFFILL

Fill shall be of well compacted, well graded earth or sand and shall be free from tree stumps, organic matter, seed and peat etc. Where earth or sand from source other than excavation at site is used, the quality of such earth or sand shall be the same as that obtained from excavation at site, or superior to it. Fine sand for filling is River Sand. Black cotton soil shall not be used for back filling or plinthfilling.

1.7.3 COMPACTION

The fill shall be spread in layers not exceeding 20 cm thick and each layer shall be watered and thoroughly consolidated by suitable mechanical rollers, rammers, vibrators or other approved plant or system of compaction. The fill material shall be pulverized before depositing in place. An optimum moisture content shall be maintained for the filled materials. Compaction shall be done so as to achieve a dry density of not less than 90% of the maximum density obtained at optimum moisture content, except for the upper 20 cm layer which shall be compacted to a density of not less than 95% of the maximum density. In order that the fill shall be reasonably uniform throughout, the material shall be dumped in place in approximately horizontal layers "Edge dumping", a process by which the materials is pushed off edge of the fill and allowed to roll down the slope shall not be carried out. If there is traffic over the fill during construction, either by construction equipment or otherwise, it should be routed to make the compaction as uniform load shall be maintainedandalsocareshallbetakentopreventanywedging action.

1.8 SURPLUS EXCAVATEDMATERIAL

All excavated material certified as surplus and not useful, shall be removed by the Contractor from the site in an approved manner at his own cost and risk so as indemnify owner from any claims any time of whatsoever nature.

1. SPECIFICATIONS FOR ANTI-TERMITE TREATMENT

2.1 GENERAL

Prevention of termite from reaching the super structure can be achieved by creating a chemical barrier between the ground and the building by treating the soil beneath the building and around the foundations. The work shall be carried out as per IS 6313 part II. of 2001 or the latest edition. This shall be provided to sides

and

bottom of trenches and footings including treating the backfill of foundations up to ground level and the vertical surface of wall, and filling of each under floors and treating the surface at ground level 900 mm around thebuilding.

2.2 MATERIAL

Anti-termite treatment, shall be carried out strictly in accordance with CPWD specifications using Chlorpyrifos (CPP) an **Emulsified concentrate @ 1%** concentration or any other approved chemical.

2.3 PRE-CONSTRUCTION CHEMICALTREATMENT

This is a process in which chemical treatment is applied to a building in the early stages of its construction at the rate specified In **IS 6313 part II of 2001** or the latest edition. Hand operated pressure pump shall be used for uniform spraying of the chemical. To have proper check for uniform spraying of chemical graduated containers shall be used. Proper check should be kept that specified quantity of chemical is used for the required areas during the operation.

2.4 TIME OF APPLICATION

Soil treatment shall start when foundation trenches and pits are ready to take lean concrete in foundations. Laying of lean concrete shall start when chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for thefloor.

2.5 DISTURBANCE

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.6 TREATMENTOFCOLUMNPITSANDWALLTRENCHES

- a) The bottom surface and the sides (up to a height of above 300 mm) of the excavation made for column pits and trenches shall be treated with the chemical at the rate specified in IS 6313 Part II of 2001 or the latestedition.
- b) After the column foundation and the wall foundation come up, the back fill in immediate contact with the foundation structure shall be treated at the rate specified in IS 6313 Part II of 2001 or the latest edition of the vertical surface of the substructure for each side If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by prodding the earth at 150 mm centers close to the wall surface and spraying the chemical with the above dose. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical

emulsion shall be directed towards the concrete to masonry surface of the columnsand walls so that the earth in contact with these surfaces is well treated with the chemical.

c) In the case of R.C.C. framed structure with columns and plinth beams and R.C.C basement with concrete, mix is rich and dense (being 1:2:4 or richer), it is unnecessary to start the treatment from the bottom of excavation for columns and plinth beams. The treatment shall start at the depth of 500 mm below ground level. From this depth the back-fill around the columns, beams and R.C.C. basement wall shall be treated at the rate as per IS 6313 Part II of 2001 or the latest edition. The other details of treatment shall be as laid down in the Clause (b)above.

2.7 TREATMENT OF TOP SURFACE OF PLINTHFILLING

The top surface of the filled earth within plinth wall shall be treated with chemical emulsion at the rate as per IS 6313 Part II 2001 or the latest direction (surface area) before the sand/sub -grade is laid. Holes up to 50 to70 mm deep at 150 mm centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with chemicalemulsion.

2.8 TREATMENTOFJUNCTIONOFWALLANDFLOOR

To achieve continuity of the vertical chemical barrier on inner wall surface from the ground level, small channel 30 X 30 mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel up to ground level 150 mm apart and the chemical emulsion poured along the channel as per rate of application, mentioned in IS 6313 Part II (2001) or the latest edition soastosoakthesoilrightuptobottom.These oilshallbetampedbackintoplaceafterthisoperation.

2.9 TREATEMENTOFSOILALONGEXTERNALPERMIETEROFBUILDING

During progress of work, provide hole in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and depth 300 mm and filling these holes with chemical emulsion at the rate (as per IS 6313 Part II of 2001 or the latest edition) per meter of perimeter of the externalwall.

2.10 TREATMENT FOR EXPANSION JOINTS

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub grade has been laid as per IS 6313 Part II of 2001 or the latest edition.

2.11 TREATMENTOFSOILSURROUNDINGPIPESANDCONDUITS

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe, or conduit for a distance of 150 mm and up to depth of 75 mm before treatment is commenced When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 75 mm for distance of over 300 mm from ground level.

2.12 SAFETYPRECAUTIONS

All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapors or spray mists or swallowed.

Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below.

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labeled and should be stored carefully so that children and pets cannot get at them. They should be kept securelyclosed.

Special care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided Workers should wear clean clothing and should wash thoroughly with soap and water, especially before eating or smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water, if chemicals splash into the eyes, they should be flushed with plenty of fresh water and immediate medical attention should besought.

The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed nearby during the mixing. Care should be taken in the applications and present a fire hazard owing to the use of petroleum solvents Flames should not be allowed nearby during the mixing.

Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

2.13 GUARANTEE

The contractor shall guarantee through a guarantee bond, the anti-termite work for 10 years from the date of completion of the project, and shall indemnify the Project-incharge against any defects that arise therein during the guarantee period as aforesaid. They shall immediately rectify, any defects that may occur therein, and repair all other damage occurring to any part of the structure on account of defect in Anti-termite treatment, during the guarantee period of aforesaid.

3. SPECIFICATION FOR CAST – IN – SITU REINFORCED CEMENTCONCRETE

3.1 GENERAL

3.1.1 DESCRIPTION

This section covers the requirements for finishing of cement concrete, proportioning, batching, mixing, testing, placing, compacting, finishing, jointing, curing and all other work as required for cast in place reinforced concrete. The contractor shall provide all the materials including cement, steel, labour, equipment, 'form work', scaffolding etc., required for completion of all reinforced concrete works as per drawings and documents. Cement concrete shall be composed of cement, fine aggregate, coarse aggregate, water, with or withoutadmixtureasapproved, proportionedandmixed asspecifiedherein.

3.1.2 RELATED WORK SPECIFIEDELSEWHERE

- a) Steelreinforcement
- b) Formwork

3.1.3 APPLICABLE CODES ANDSTANDARDS

The codes and standards generally applicable to the work of this section are listed hereinafter. IS 383 Coarse and fine aggregates from natural sources for concrete

IS 456 Code of practice for plain and reinforced concrete IS 516 Methods of

testing for strength of concrete

IS 1199 Methods of sampling and analysis of concrete

IS 1838 Performed fillers for expansion joints in concrete nonextruding and resilient type IS 1946 Code of practice for use of fixing devices in walls, ceiling and floors of solid

Construction

IS 2389 Methods of testing of aggregate for concrete's IS 2505 Concrete vibrators, immersion type IS 2645 Integral cement water proofing compounds IS 3414 Code of practice for design and installation of joints in buildings IS 3558 Code of practice for use for immersion vibrators for consolidating concrete IS 4082 Recommendation on stacking and storage of construction materials at IS 7861 Code of practice for extreme weather concretizing IS 7861 Recommended practices for hot weather (part I) concretizing IS 8112 Ordinary Portland Cement grade 43 IS 120(9 Ordinary Portland Compart grade 52

IS 12269 Ordinary Portland Cement grade 53

PART— I

The following clauses are intended to amplify the requirements of the reference document listed above and the contractor shall comply with these clauses

3.2 SUBMITTALS

3.2.1 MaterialReport

3.2.2 Prior to start of delivery of materials required, the following shall be submitted by the contractor to the Consultant / Project-in-charge forapproval

Suppliers and / or sources of all consumable materials including cement, steel, fine and coarse aggregates, water additives, bricks and timber etc.

Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the Consultant on the quality of materials being supplied.

PLANT ANDEQUIPMENT

The contractor shall submit the following to the Consultant well in advance. The proposed program, methods and details of plant and Equipment for be used to testing of ingredients and concrete samples.

The proposed programmed methods and details of plant & equipment to be used for concrete work.

3.3 **REPORTS FOR INSPECTION ANDTESTING**

During concreting operations, the contractor shall conduct inspection and testing as described under the list of mandatory tests in this volume and all reports thereon shall be submitted in summary form to the Consultant / Project-in-charge.

3.4 SCHEDULES

Before commencement of the work the contractor shall prepare working schedules of concreting giving dates and rate of pour for each item of work and submit the same to the Consultant / Project-in-charge for their approval.

3.5 MATERIALS

Before bringing to the site, all materials for cement concrete shall be approved by the Consultant / Project-in- charge. All approved samples shall be deposited in the office of the Consultant / Engineer-in charge before placing orders for the materials with suppliers The materials brought on to the work shall conform in every respect to their approved samples.

Fresh samples shall be deposited with the Consultant / Project-in-charge whenever type or source of any material changes the contractor shall check each fresh consignment of materials as it is brought on to the works to ensure that they conform to the specification and / or approved samples.

The Consultant / Project-in-charge shall have the option to have any of the materials tested to find whether they are in accordance with specifications at the contractor 's expense. All bills vouchers and test certificates which in the opinion of the Consultant / Project-in-charge are necessary to convince him as to the quality of materials or their suitability shall be produced for his inspection when required.

Any materials which have not been found to the specification and not approved by the Consultant / Project- in-charge shall be rejected forthwith and shall be removed from the site by the Contractor's at his own cost within the time stipulated by the Consultant / Project-in-charge. The Consultant / Project-in-charge shall have the powers to cause the contractors to purchase and use materials from any particular source, as may in their opinion be necessary for the proper execution of work.

3.5.1 CEMENT

Cement shall be provided by the Contractor. On the following types of cement as specified shall be used

a. OrdinaryPortlandCement43gradeconfirmingtoBIS8112-1987

b. OrdinaryPortlandCement53gradeconfirmingtoBIS12269-1987

Cement at site shall be stored in dry weather proof go-downs (or shed) built by the Contractor at his own costs in stacks which are not higher than 10 bags. The cement go-down shall be constructed as per CPWD specifications. The contractor shall conduct all necessary tests as specified in the IS, at his own cost to ascertain himself on quality of thematerial.

3.5.2 AGGREGATES

- a) Aggregates from natural sources shall be in accordance with IS:383. The contractor shall submit to the Consultant / Project-in-charge certificates of grading and compliance from the suppliers for all consignments of aggregate. In addition, at site from time to time, the contractor shall test the aggregates in accordance with IS: 2386 parts I, II, III and IV. The contractor shall allow for and provide all necessary apperitusfor carrying out each test and for supplying test records to theConsultant.
- b) For fair faced concrete, the contractor shall ensure that aggregates are free from iron pyrites and impurities which may causediscoloration.
- c) The fine aggregates shall be river sand, stone dust or other approved sand. It shall be free from clay, loam, earth or vegetables matter and from salt or other harmful chemical impurities It shall be dean sharp, strong angular and composed of hard siliceousmaterial.

The grading of sand as determined by the method prescribed in IS: 2386 part I shall be within the limits of grading zone III given in Table 1. When the grading falls outside the percentage limits given for sieves other than 600-micron, 300 microns, and 150-micron (I.S) sieves by not more 5 percent, it shall be regarded as fallingwithin this zone. The 5 percent can be excess submission on one moresieve. FINE AGGREGATE I. S.Sieve

Percentage passing forGrading

IV	ZONEI	ZONEII	ZONEIII	ZONE IV
10 mm	100	100	100	100
4.75 mm	90-95	90-100	90-100	95-100
2 36 mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	35-60	80-100
300 microns	5-20	8-30	8-30	20-65
150 microns	0-10	0-10	0-10	0-15

The maximum quantity of silt as determined by the method prescribed in IS: 2386 Part II shall not exceed 8%.

Stone dust shall be within the limits of Grading Zone III given in table 1. When the grading falls outside the percentage limits given for the sieves other than 600 micron and 300-micron (IS) sieves by not more than 5 percent and on 150-micron sieves by not more than 20 percent it shall be regarded as falling within this zone. The 5 percent can be excess summation on one or more sieves.

COARSE AGGREGATE

The coarse aggregate shall be crushed stone or broken stone. Coarse aggregate obtained from crushed or broken stone shall be angular, hay, strong, dense, durable clean and free from soft, friable, thin, flat, elongated flaky pieces. The coarse aggregate should be from the approved source/quarry. Coarse aggregate River shingle or pit gravel shall be rounded, sound hard, clean, non-porous, suitably graded in size with or without broken fragments and free from flat particle of shale, clay, silt, loam and otherimpurities.

Except where it can be shown to the satisfaction of the Consultant than a supply of properly graded aggregate of uniform quality can be maintained over the period of the obtaining the coarse aggregate in different sizes & blending them in correct proportions as and when required.

The maximum size of coarse aggregate shall be such that the concrete can be placed without difficulty so s to surround all reinforcement thoroughly and fill the comers of form work.

3.5.3 WATER

Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh and clean, free from injurious mountsofoil, salts,acids,alkali, otherchemicalsandorganicmatter. Water shall be from the source approved by the Consultant / Project-in-charge and shall be in accordance with Clause 4.3 of IS:456.

Before starting any concreting work and whenever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Consultant. No water shall be used until tested and found satisfactory. Cost of all such tests shall be borne by the contractor.

3.5.4 ADMIXTURES ANDADDITIVES

Chemical admixtures are not to be used until permitted by the Consultant/Projectin-charge in case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall besubmitted to the Consultant forapproval

The contractor shall further provide the following information concerning each admixture to the Consultant/Project-in-charge.

- a) Normal dosage and detrimental effects, if any, of under dosage and overdosage.
- b) Thechemicalnamesofthemain ingredientsintheadmixture.
- c) The chlorideion content, if any, expressed as a percentage by weight of admixture.
- d) Whether or not the admixture leads to the entertainment of air when used in the manufacturer's recommended dosage.
- e) Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility.

In reinforced concrete, the chloride ion of any admixture as determined in accordance with IS: 6925 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.30n percent by weight of cement. The admixtures when used shall conform to IS: 9103. The suitability of all admixtures shall be verified by trialmixes.

The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

Regarding admixtures when used shall be based on lingo-sulphonates with due consideration to clause 5.2 and 5.30 of IS:7861.

Waterproofing admixtures shall comply with IS: 2645.

3.6 PLANT

The contractor shall obtain the approval of the Consultant/Project-in-charge for all plant items he proposes to use for the manufacture and placing of concrete. The arrangement shall maintain all items of plant at all times in a clean and efficient working condition.

3.7 STORAGE

All goods and products covered by these specifications shall be procured well in advance and stored as specified below.

3.7.1 CEMENT

Cement shall be stored on a raised floor in dry weather **proof & dust free but** well-ventilated shed.

Cement bags shall be stacked close together away from external walls and in stacks of not more than ten bags to avoid lumping under pressure.

Cement stored during monsoons or cement expected to be in store for more than eight weeks shall be completely enclosed in 700-micron polyethylene sheet so arranged that the flap closes on the top stack. The contractor shall ensure that protective polyethylene sheet is not damaged at any time during use.

Consignments of cement shall be used in order of delivery A record shall be kept of the batch numbers of cement deliveries in such a form that the part of the works in which the cement is used can be readily identified. If during delivery or by test, the cement is found to be defective, the same shall be returned back forthwith.

The contractor shall be responsible for the storage of cement at the site and no claim will be entertained in the event of any damage occurring to cement due to faulty storage by the contractors or on account of his negligence.

Cement stored on site for aperiod longer than eight weeks shall be tested to the satisfaction of the Consultant/Project-in-charge before it is used in the works. Cement that has failed the tests conducted shallnotbeusedintheworksandshallberemovedfromthesiteimmediatelywithoutfail.

3.7.2 STORING OFAGGREGATE

Aggregates shall be stored on a suitable welldrained raftof concrete, timber, metal or other approved material. The storage of aggregates on the ground will not bepermitted.

Each size of aggregate shall be stored separately in such a manner as to prevent spillage and mixing of one aggregate with an adjacent aggregate. The dividing walls of any bin shall be of sufficient height and the aggregate shall be so deposited that a distance of 100 mm shall beleft between the top of the division wall and any part of the aggregatestack

When stack piling, the aggregate shall not form pyramids resulting in segregation of different size particles. The stacks shall be regular and of a height not exceeding two meters.

3.8 GRADES OFCONCRETE

The grades of concrete shall be in accordance with the following table. The grade of concrete to be used in each section of work will be shown in the drawings or in the Bill of Quantities:

CHARACTERSTIC STRENGTH

Grade of Concrete	Grade of Concrete Characteristic strength i.e., compressive strength of 15 cm. Cubes at 28 days (N/mm2)	Nominal maximum aggregate size (mm)
1]	2
0	0	5
1	1	2
5	5	5
2	2	2
0	0	0
2	2	2
5	5	0
3	3	2
0	0	0
3	3	2
5	5	0

Unless otherwise specified in the drawings, the maximum nominal size of coarse aggregates for different grades of concrete shall be as under:

a) For concreting in very narrow space or in verysmallthickness 12mm

b) For all reinforced concrete work except inmassive foundations 20mm

c) For all ordinary plain concrete and massivereinforcedfoundations 10mm

All mix design grades viz., M10, M15, M20, M25, M30 etc., shall be designed and have a minimum cement content as follows:

Grade	Qty	(in
M 10	kg)	
101-10	200	
M-15	300	
M-20	400	
M-25	600	
M-30	800	

Minimum content of cement remaining unchanged, as specified above for each type of concrete mix, the proportion and quantities of local sand and aggregate are to be worked out and determined in the field/laboratory as per Road Research Note No.4, Department of Scientific and Industrial Research, United Kingdom for design of concrete mixes or as per ACI 613 with the approval of the Engineer. Any change in the source of aggregates will require the re-designing of the concrete mix for the Engineer's approval.

3.9 MixDesign

At the commencement of the contract, the Contractor shall make preliminary tests to determine the proportions by weight of cement, fine aggregates, coarse aggregates and water necessary to produce required grades of concrete. The mix

proportions shall be selected to ensure that workability of the fresh concrete is

suitable for the conditions of handling and placing and when concrete hardens, it shall have the required strength, durability and surface finish. The Contractor shall get approval of the Engineer to such proportions before start of concreting. However, such approval shall not relieve the Contractor of his responsibility to produce concrete having compressive strengths as laid down in the foregoing table.

No departure from the approved proportions will be permitted during the works unless and until the Engineer gives written authorization for any change in proportion. The Engineer shall have authority at any time to checkwhetherthemixingofconcreteisbeingcarriedoutaccordingtotheapprovedpro portions.

For the major and important RC works and for all special works, the design of mixes shall be made by the Contractor at his own cost, for each grade of concrete as well as for various workability. The design of mixes shall be made according to relevant I.S. codes or to approved standard methods.

The concrete made by designing the mix is termed hereinafter as "Design Mix Concrete".

3.10 Water/CementRatio

Where a particular water/cement ratio is stipulated in the design or drawing along with the characteristic grade of concrete, the design of mix shall be carried out by adjusting the other variable factors to obtain characteristicstrengthofconcretewithstipulatedwater/cementratio.

In the structures where the impermeability and shrinkage of concrete have an important bearing on the durability and serviceability of the structures, such as water retaining structures, basements, underground premises, tunnels, pump houses, exposed structures near sea side or deserts, pre-stressed structure, thin precastmembersetc., the water/cementratioshall bekeptlowandpreferablynotexceeding0.45.

The water cement ratio as achieved in the mix design or as specified in the drawings shall be adhered to strictly and shall not be varied without the permission of the Engineer.

3.11 Workability

The workability of fresh concrete shall be such that the concrete is just suitable for the conditions of handling and placing so that after compaction, it becomes completely consistent and homogeneously surrounds all the reinforcement and completely fills the formwork.

The workability of fresh concrete at the place of batching/mixing shall be measured by compacting factor test and at the place of disposition by means of slump test. During the finalization of trial mixes, the relationship between compacting factor and slump test shall be established for each grade of concrete as wellas forvarious levels forworkability. Normally, in the condition of low water cement ratio as well as for medium/high workability, the workability shall be achieved by increasing the cementcontent.

In cases where the cement content is to be limited to reduce the heat of hydration, and the water / cement ratio is also to be kept low to reduce the permeability or due to other requirements the desired workability may be achieved with the use of limited doses of plasticizer or air entraining agent. In such cases, the method of mixing and dosage of the plasticiser / air entraining agent shall be according to the manufacturer's specification and with the approval of theEngineer.

Consistency and workability of concrete shall be checked by measuring the slump of a truncated cone of concrete straight from the mixer under normal working conditions. The conical mould shall be of metal, 300 mm high and 100 mm and 200 mm in diameter at top and base respectively.

Moulds shall be prepared by the Contractor. The slump range of concrete shall be as per the tabulation given below, as well as standards.

Slump tests shall be performed as per IS:1881 at intervals established by the Engineer at the Contractor's costin such a way as to check that the degree of consistency established by the Engineer for work in progress is maintained. The table below gives the general slump range to be followed for various types of construction unless otherwise shown on drawings or instructed by the Engineer

Various types of construction	Slump (in mm)	MAX		Min
Reinforced foundation walls and		80	35	
Tootings				

Compressor foundations and for heavymassconstruc	tions	50	20
Pumps and other misc.equipmentfoundations	75		35
Columns, slabs, beams and reinforced walls	100		50

3.12 Durability

The durability of concrete, depending on the exposure condition, is to be taken into account while designing the mix. For given aggregates, the cement content should be sufficient to make sufficiently low water/cement ratioandAppendixAofIS:456shallbetakenasguidelinefordurabilityconsiderations.

3.13 TrialMixes

After approval of the mix design by the Engineer, the Contractor shall make in presence of the Engineer the trial mixes for each grade of concrete as well as for requiredworkability.

Before starting the trial mixes, necessary preparatory works like determination of sieve analysis of the aggregates, densities of different ingredients, moisture contents in the aggregates, shall be completed according to the relevant BIS Codes.

Each trial mix shall be handled and compacted by the method which the Contractor proposes to use for that mixing the worksandthemixesshallnot showtendencyofinadequatecompactionbythemethodproposed.

The compacting factor and the slump of each trial mix shall be determined immediately after mixing and the values shall not exceed the maximum value obtained in the mix design.

Five (5) 150 mm test cubes shall be made from each trial mix. These shall be cured and tested in accordance with relevant BIS codes. In order to have the specified characteristic strength in the field, the concrete mix as designed in the design mix shall have higher average compressive strength depending on the degree of quality of control atsite.

Before commencement of the concreting works of particular grade of concrete, the Contractor must complete the work of trial mixes and subsequent testing of the test cubes obtained there from and the desire of the approved mix for that particular grade of concrete.

The entire cost of all the trial mixes including all the preparatory works for trial mixes, preparation of test cubes and their testing shall be borne by the Contractor.

3.14 Nominal MixConcrete

Nominal mix concrete may be used for all concrete of grade M-10 and below. If design mix concrete cannot be used for any reason for grade M-15 and M-20, nominal mix concrete may be used with the permission of the Engineer. Nominal mix concrete shall be in accordance with Table-3 of clause 8.3 of 1 S 456. The stipulationsofclauses8.3.1and8.3.2ofIS:456shallalso betakenintoconsideration.

3.15 Volumetric MixConcrete

Where concrete is specified in volumetric proportions such as 1:4:8, 1:3:6, 1:2:4, 1:1.5:3, 1:1:2 etc., in the Bill of Quantities, coarse & fine aggregates shall be measured by volume & cement by weight. The water cement ratio shall be within 0.45 & 0.70 depending upon the workability.

3.16 Batching ofConcrete

3.16.1 Cement

Cement shall always be batched by weight. A separate weighing device shall be provided for weighingcement. Where the weight of cement is determined by accepting the weight per bag, a number of bags shall be weighed separately to determine the average net weight of cement per bag and the same shall be checked regularly.

3.16.2 Aggregates:

For both design mix concrete and nominal mix concrete, the aggregates, (coarse and fine) shall be batched by weight.

In particular cases, or where weight-batching is not possible, proportioning by volume batching may be allowed by the aggregates throughout the period of construction. For this purpose, the Contractor shall submit to the Engineer sufficient data indicating the weight/volume relationship of the aggregates shall be made by the Contractor to the satisfaction of the Engineer. Where aggregates are moist and volume batching is adopted, allowance shall be bulking in accordance with IS (PartIII).Suitable adjustments shall be made for the variation in the weight of aggregates due to variation in their moisture contents.

3.17 Water

3.17.1 General

Water may be measured either by weight or by volume. When measured by volume, it shall be by well calibrated conical shaped jar or vessel or from a calibrated tank filled to the mixer.

Adjustment of Water Due to Moisture Contents in Coarse and Fine Aggregates It is very important to maintain the water cement ratio constant at its correct value. For the correct determination of the amount of water to be added in the concrete mix, to maintain the water cement ratio constant, the amount of moisture content in both coarse and fine aggregates shall be taken into consideration, be checked as frequently as possible, the frequency for a given job being determined by the Engineer according to weather condition.

Determination of Moisture Content in the Aggregates

Determination of moisture content in the aggregates shall be according to IS 2386 (Part-III). Where tests are not conducted, the amount of surface water may be estimated from the following table:

Aggregates	Surfacewater	Carried byAggregates
	% by weight	l/m3
Very wet sand	7.50	120
Moderately wet sand	5.00	80
Moist San	2.50	40
Moist gravel stone chips*	125.25	20-40

• coarser the aggregate, less the water it willcarry

3.17.2 Admixtures

Any solid admixture, to be added, shall be measured by weight, but liquid or semiliquid admixture may be measured by weight or volume.

The Bidder shall indicate the brand name, the Manufacturer and the properties of any admixture to be used for the concrete as per Bill of Quantity items or on his owninitiative.

3.17.3 Accuracy of Batching

The accuracy of batching shall be within the following tolerance: 1 Cement within + 2% byweight 2 Aggregate within + 5% byweight 3 Water within + 0.5% byweight.

3.18 Mixing ofConcrete

3.18.1 MachineMixing

Concrete shall always be mixed in mechanical mixer. Water shall not, normally, be charged into the drum of the mixer until all other ingredients are already in the drum and mixed for at least one minute. Mixing shall be continued until there is uniform distribution of materials and the mass is uniform in colourand consistency. The mixing time from the time of adding water shall be in accordance with IS 1791, but in no case less than 2 minutes or at least 40 revolutions.

3.18.2 HandMixing

When hand mixing is permitted by the Engineer, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colourand consistency. In case, ofhandmixing, 10% extracements hall be added to each batch at no extracost to EMPLOYER,

3.19 Transportation of Concrete

Concrete shall be transported from the place of mixing to the place of placing concrete as rapidly as practicable by any means, which will prevent the segregation or loss of any of the ingredients and maintain the required workability. No water shall be mixed with the concrete after it has left themixer.

Where concrete is transported over long distances, the Contractor shall provide suitable means by which different grades of concrete are readily identifiable at the place of final deposit.

3.20 Preparatory Works/SurfacePreparation

3.20.1 For Concrete Directly on EarthFoundation

Earth foundation on which direct placement of concrete is specified, shall be rammed and consolidated as directed by the Engineer such that it does not crumble and get mixed with concrete during or after placement. If the foundation is quite wet, the same shall be kept dry and then sufficiently consolidated, if necessary, a thin top layer of the wet soil shall be removed and replaced by sand or other suitable materials as directed by the Engineer without extra cost to EMPLOYER, Care shall also be taken that earth from the sides also does notgetmixedwiththeconcrete,duringrafterplacement,beforeithassufficientlysetandh ardened.

The earth foundation, over which concrete is to be placed directly, shall not be kept abandon at the specified level and concrete shall be placed immediately following otherwise suitable measures shall be taken, as directed by the Engineer **without extra cost** to EMPLOYER.

3.20.2 For ConstructionJoints

Concrete shall be cast, as far as possible, continuously until the parts of structure to be built are finished. Should this not be feasible, the type, number and location of construction joints shall be approved by the Engineer prior to placing concrete.

All such joints shall have continuous square bond grooves to produce substantial and water-tight-key and the exposed faces of joints shall be monolithic with the main mass of concrete formed and completed under substantially shattered faces. The Contractor shall take all the necessary steps by means of timber edgings etc. to ensure an exact horizontal straight finish to outside edge of any lift of concrete. Subject to the approval of the Engineer, the Contractor is at liberty to arrange his own construction joints but the following restrictionsare to be observed:

- 1. There shall be no vertical constructionjoints
- 2. No longitudinal joints shall be made in the walls and floors of trenches and pits unless otherwise shown in thedrawings.
- 3. Concrete pouring shall be reasonably argebutinnocase shall the height of pouring concrete exceed 1.5 m without the Engineer's firm approval. Such approval of the Engineer shall not in any way relieve the Contractor of his responsibility to ensure that the construction is water tight and that no segregation takes place.
- 4. Laitance shall be removed from the surface of concrete before it has set hard by washing and wire brushing so as to expose the stones of the top layer without undue erosion of the mortar or damage to the under layingconcrete.

All beds and joints in concrete faces, which have become set, are to be picked all over and all loose materials removed before fresh concrete is deposited thereon. The indentations shall be at least 12 mm deep and not lessthanseventyfivepercentoftheareaoftheexistingconcretefacetobecoveredover. Immediately before depositing fresh concrete, the exposed surface shall be cleaned of foreign matter by further wire brushing, if necessary. It shall then be thoroughly washed and surplus water removed. The surface, while still moist, shall be covered with layer of 1:1 cement mortar which must be vigorously stippled into the surface by means of a stiff brush, the depositing of the fresh concrete following on closely. Pockets to form keys shall be left in the surface of the concrete at constructional joints, 75 mm deep and approximately **equal to 20% of the exposedsurface.**

All costs in connection with the forming of construction joints shall be to the account of the Contractor and shall be deemed to be included in the rates for concreting and formwork and shall not be separately paid for. In a column, the joint shall be formed 75 mm below the lowest soffits of the beams, including haunches, if any.

Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable, then the joint shall be vertical and at the center of, or within, middle third of the span, unless otherwise shown on the drawings.

3.20.3 On Vertical Surfaces of Masonry

When the concrete is placed on the vertical surface of masonry (as in the case of thin concrete fins projected from the vertical masonry surface), a groove of dimension as directed by the Engineer shall be cut in the masonry to ensure a proper bond and the surface shall be cleaned thoroughly. Before the placement of concrete, the surface shall be kept moist by spraying water at least for the period of 2 hours and a thick coat of cementslurryshallbeapplied immediatelybeforetheplacementofconcrete.

Inside the Form Works (Cleaning, Surface Preparation etc.)

The interior of the form works, where the concrete is to be placed, shall be thoroughly washed by high pressure water jet or air jet to completely clean the entire volume from the dirts, grease/oil foreign and deleterious materials etc. The reinforcements shall be completely cleaned and free from all sorts of dirts grease/oil, rust, foreign/deleterious materials etc. Before placement of concrete, the form works coming in contact with concrete, shall be coated highly with form oil or raw linseed oily material or provided with any approved material to prevent adhesion of concrete to the form work, but utmost care shall be taken so that such oily material does not come in contact with thereinforcement.

3.21 Placing and Compaction of Concrete

Before placing the concrete, the Contractor shall ensure that:

- 1. Allmixingandplacingequipmentarethoroughlycleaned
- 2. All concreting space is free from debris andrubbish

- 3. All forms have been thoroughly wetted or oiled and firmly installed in line and plumb to the Engineer'sapproval.
- 4. All reinforcement is cleaned of loose rust, scales and other injurious adherents and is firmly bound andcorrectlyplacedandhasbeensoapprovedbytheEngineer.
- 5. All inserts, sleeves, foundation bolts and embedded parts have been correctly and firmly installed to conform to the Engineer's drawings and have been carefully checked to comply with the drawings. Special care shall be taken to locate and check sleeves or inserts, which may not be symmetrically placed with respect to centerlines.

The Contractor and Engineer shall separately inspect and check the abovementioned points and record and sign the results in a register which shall be maintained by the Contractor in an approved form. No concrete shallbe placed without the Engineer having inspected and approved in writing. Inspite of ensuring the above requirements, the Contractor shall fill pour cards furnishing the necessary details of the job, duly signed by the Engineer. This, however, will not absolve the Contractor from his responsibility to correctly execute the work. Pour cards shall contain the followinginformation:

Design Index

- Date
- Slump
- Workability
- Work testspecimen
- Typeoffinishingandadmixturesused(ifany)
- Period of removal ofshuttering/props/forms.
- a. The concrete pouring method shall be submitted to the Engineer for approval and shall always be such as to avoid any possibility of segregation of the components or shifting of thereinforcement.
- b. Special grout or mix shall be used for difficult and intricate locations as specified by the Engineer. During placing, the concrete shall be thoroughly worked around reinforcement, embedded parts and corners of theformwork.
- c. Greatest possible care shall be taken by the Contractor that reinforcement and embedded parts, particularly foundation bolts and sleeves, are not displaced during placement of concrete. While concreting mats and other such locations where top and bottom reinforcement are adopted, top reinforcement shall be thoroughly cleaned of all slurry and mortar sticking to them at the time of concreting toplayers.
- d. The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed. No water shall be mixed with the concrete after it has left the mixer. Method of placing should be such as to preclude segregation. Approved mechanical vibrator shall be used for compacting concrete, and concrete shall not be non-vibratoor under vibrated. No concrete shall be placed until the place of deposit has been thoroughly inspected and approved by the Engineer, all inserts and embedment properly secured in position and checked and forms properly oiled. No concreteshallbeplacedintheabsenceoftheEngineer.

- e. Concrete shall be placed on clean bed having the designed level. The bed shall be cleaned of all debris and other objectionable materials. Seepage water, if any, shall be controlled ordiverted.
- f. Concreting shall not be carried on during rains unless all precautions have been taken by the Contractor and necessary permission has been given by the Engineer. Suitable measures shall be taken to control the temperature ofconcrete.
- g. Where plums are permitted in massive concrete, they shall be washed and carefully placed. No stone shallbecloserthan30cmtoanexposedface, nornearerthan15cmtoanadjacentstone.
- h. Concrete shall not be dropped from a height of more than 2 m except through a chute, the design and type of which shall be subjected to approval of the Engineer.
- i. The concrete shall be placed, spread and compacted by approved mechanical vibrator. Vibrators shall not be used for pushing concrete to adjoiningareas.
- j. For members involving vertical placing of concrete (e.g., columns, walls etc.), each lift shall be deposited in horizontal layer extending for the full width between shuttering and of such depth that each layer can be easily and effectively vibrated and incorporated with the layer below by means of compaction beingemployed.
- k. For members involving horizontal placing of concrete (e.g., slabs, beams etc.), the concrete shall be placed along the line of starting point in such quantities as will allow members to be cast to theirfulldepth along the full width between side shuttering and then gradually brought towards the finishing point along its entire front parallel to the starting line. Vibration and surface finish shall follow behind the placement as closely aspossible.
- 1. Utmost care shall be taken to avoid the displacement of reinforcements/ embedded parts or movementof form work or damage to faces of the form work or transmission of any harmful vibration/shocks to the concrete which has not yet hardenedsufficiently.
- m. All members shall be concreted at such a rate that no cold joint is formed and fresh concrete is placed always against green concrete, which is still plastic andworkable.
- n. Should any unforeseen occurrence result in a stoppage of concreting for one hour or such other time as might allow the concrete, already placed, to begin to set before the next batches can be placed, the Contractor shall make at his own cost, suitable tongue, and groove construction joint, as approved by the Engineer. Any additional reinforcement required as directed by the Engineer shall also be provided by the Contractor at his own cost. Before placement of new batches of concrete over that construction joint, the surface preparation according to this specification stipulated earlier, shall be done by theContractor.
- o. The concrete shall be worked well up against whatever surface it adjoins and compacted to such a degree that it reaches its maximum density as a homogeneous mass, free from air and water holes and penetrates to all corners of moulds and shuttering and completely surrounds the

reinforcement. All measures shall be taken to make the shape, size, and location of the finished concrete including its embedment, holes, openings etc., well within the accepted tolerancelimit.

3.22 ConstructionJoints

Normally, the construction joints including crack inducing joints shall be constructed as per locations and details indicated on the drawings. Where the location of the joint is not specified in the drawings, it shall be in accordance with the following guidelines. In all construction joints, the reinforcements shall pass through as per drawingsand the same shall not be disturbed in any way.

- a) InColumns
 - i) In case of Projection from Basement Slab, 300 mm from the top of base slab or 75 mm from the top of the haunches whichever ishigher.
 - ii) In framing the beam at different elevation, 75 mm below the lowest soffit of the beam and in caseofprojection from beams and slabs 75 mm from the top surface of the beam/slab or at the top surface of beam/slab whichever facilitatesformwork.
 - iii) Forcolumnsbelowflatslabs, 75mmbelowthelowestsoffitoftheslab.
- b) In Walls (Horizontal Construction Joints)
 - i) For WallsProjectingfromBaseSlab, 300mmfromtopofbaseslab.
 - ii) ForWallssupportingthesuspendedslab,75mmfromthelowest offitoftheslab.

Note: In the case of water retaining structures and structures under the influence of ground water, approved water bars of suitable size shall be provided to make the joint completely watertight.

c) InBeams

Beams shall be cast, as a rule, without a joint. But if provision of a joint is unavoidable, the joints from simply supported beam shall be vertical and at the middle of the span; in continuous beam, the same shall be at the point of minimum shear force.

- d) In SuspendedSlabs
 - i) In slab of small span, there shall be reconstructionjoints.
 - ii) In slabs of large span and continuous slabs, the Construction joint, if allowed by the Engineer, shall be vertical at the middle of span and at right angles to the principalreinforcement.
- e) In Walls (Vertical ConstructionJoint)

As a rule, walls shall be cast monolithically without any vertical construction joint, unless specified in the drawing. However, for a long wall, Engineer may allow vertical construction joint and the same shall be at the place of minimum shearforce.

f) In Slabs Resting onGround

- For PlainConcrete
 Concreting shall be done in alternate panels not exceeding 10 m² in area.
 The largest panel dimension shall be 5 m.
- ii) ForNominallyReinforcedSlabThearea ofpourshallnotexceed40m²andthe maximum panel dimension shall not exceed8m.
- iii) For the Basement Slabs Which Act as Structural Member There shall be no constructionjoint.
- g) In Ribbed Beams The beams shall be monolithic with the slab in onecontinuous operation.

3.23 Cold Joints:

An advancing face of pour, which could not be covered before expiry of initial setting time for unexpected reasons, is called a cold joint. The Contractor shall remain always vigilant to avoid cold joints. If, however, a cold joint is formed due to unavoidable reasons, the following procedures shall be adopted for treating it:

1. If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly over the old surface and the fresh concrete along with the old concrete shall be vibrated systematically andthoroughly.

2. In case the concrete has hardened a bit more than (1), but can still be easily removed by a light hand pick, the surface shall be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. Then a rich mortar layer of 12 mm thickness, shall be placed on one cold joint and then the fresh concrete shall be placed on the mortar layer and vibrated thoroughly penetrating deep into the layer of concrete.

3. In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise in spite of extensive vibration, a tongue and groove joint shall be made by removing some of the older concrete and the joint shall be left to harden at least for 12-24 hours. It will then be treated as regular construction joint and the surface preparation of the same, before placement of concrete, shall be as described in the appropriate clauses of thespecifications.

3.24 Sub-standardconcrete

Should the work strength of controlled concrete fall below the specified strength, Engineer shall decide:

- 1. To reject the work, in which case the Contractor shall replace the defective work with concrete of required strength and bear all costs for dismantling and replacing including cost of associated form work,reinforcement,embeddedparts&allassociatedworks.
- 2. To accept the work at a reduced rate, in which case the unit rate payable for sub-standard work will be reduced by EMPLOYER, directly in proportion to the work strength as compared to the specified strength. The Engineer may, in addition, require other tests performed on the respective structural member so accepted period to its acceptance with or without necessary corrective measures and in each such case, the Contractor shall bear all

costs for all such tests or corrective measures, besides the reduction in the unit rates as specifiedherein.

- 3. Concreteofstrengthbelowfifteen(15)percentofthespecifiedstre ngthwillnotbe accepted.
- 4. The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap underthemembers.Thetestloadshallbemaintainedfor24hoursbeforeremoval.
- 5. If, within 24 hours of the removal of the load, the structure does not show a recovery of at least 75% of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75% of the maximum deflection shown during the second test. If the structure is certified as failed by the Engineer, the cost of the load test shall be borne by theContractor.

3.25 OptionalTests

The Engineer, if he so desires, may order tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian Standards.

Tests on cement shall include

- 1. Finenesstest
- 2. Test for normalconsistency
- 3. Test for settingtime
- 4. Test forsoundness
- 5. Test for tensilestrength
- 6. Test for compressivestrength
- 7. Testforheatofhydration(byexperimentandbycalculation)inaccordancewithIS:269.

Tests on sand shall include

- 1. Sievetest.
- 2. Test for organic impurities.
- 3. Decantation test for determining clay and siltcontent.
- 4. Specific gravitytest.
- 5. Test for unit weight and bulkagefactor.
- 6. Test for sieve analysis and finenessmodulus.

Tests on coarse aggregates shall include

- 1. Sieveanalysis.
- 2. Specificgravityandunitweightofdry, looseandrode daggregate.
- 3. Soundness and alkali aggregatereactivity.
- 4. Petrographicexamination.
- 5. Deleterious materials and organicimpurities.
- 6. Test for aggregate crushingvalue.

Any or all these tests would normally be ordered to be carried out only if the Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by the Contractor at an approved test laboratory at the cost of the Contractor. If the work cubes do not give the stipulated strengths, the Engineer reserves the right to ask the Contractor to

dismantle such portions of the work which, in his opinion, are unacceptable and redo the work to standards stipulated, at the Contractor's cost. The unit rate for concrete shall be all inclusive, including making preliminary mix design and test cubes works, cubes, testing themas per specification, slump tests, optional tests etc.,

3.26 Concrete for Equipment or steel structuresfoundations: -

Concrete for equipment foundation, whether principal or auxiliary, shall be poured continuously so that the structure becomes monolithic, particular care being exercised to see that the base slabs, if any, are of compact impervious construction. Tunnels, passages, apertures and so forth shall be provided in accordance with the drawings for the installation of mechanical and electrical equipment, pipes or cables. The top elevation of the equipment foundations or parts shall be accurately cast to 20/50 mm (or more as may be specified on the drawings) above the level required for grouting and it shall be pneumatically chiseled off and well roughened just prior to the erection of the equipment concerned. All embedded anchor bolts or bolt sleeves shall be accurately and firmly set with the aid of approved templates, steel supports and/or other accessories. For holding the embedded bolts or sleeves in the correct position during concreting, template shall have to be of steel of suitable section approved by the Engineer. Two sets of templates shall have to provided, one to hold the bottom and the other the top of the bolts or sleeves. The bottom template shall be securely and rigidly fixed by providing anchorage arrangement and by welding to the lowest part of the steel reinforcement and other structural supports. The top templates shall be securely fixed by tying with guy wires and turn buckle arrangements to firm and rigid adjoining structures and staging. The bottom template that is embedded in concrete will be measured and paid for as embedded steel. Bolt pockets, where required, shall be cast with wooden taper wedges. These shall be withdrawn at an appropriate time when the concrete has set, the pockets cleaned, roughened and then covered or blocked thoroughly to prevent debris getting into these. The exposed portions of bolts and embedded parts shall be kept well-greased and adequately protected from damage throughout construction. Any damages found shall have to be corrected at the Contractor's cost. EMPLOYER, shall have the right to use the foundations, pads, piers, slabs, floors and all concrete work as needed for other works or equipment erected prior to its "TakingOver".

3.27 Finishes to Exposed Surface of Concrete

The Contractor is to include his quoted rate for concrete, the provision of normal finishes in both formed and unformed surfaces as and where required by the Engineer without any extra cost to EMPLOYER, some common finishes are indicated below:

3.27.1 Surfaces which do not RequirePlastering

Surface in contact with casing shall be brought to a fair and even surface by working the concrete smooth against casings with a steel trowel while it is being deposited and also by working over the surface with a trowel immediately after the removal of the casings or centering, removing any irregularities and stopping air holes, etc. Use of mortar plaster is not permissible for correcting levels, removing unevenness etc. However, if in the opinion of the Engineer, such plastering is unavoidable, then the thickness of plaster shall in no case exceed 5 mm and the plastering shall be in CM(1:3).

3.27.2 Faces of Foundations which will be BackFilled

Neither the smoothness of the surface not the positions of the joints in the form work are important. Small blemishes caused by entrapped air are permitted. No special surface finish is required.

3.27.3 ExposedSurfaces

Surface of beams/columns flushing with the block work or other structures where it is intended to plaster, shall be backed adequately as soon as the shuttering is stripped off so that proper bond with the plaster can develop.

3.27.4 Surface for Non-integralFinish

Where a non-integral finish such as floor finish is specified or required, the surface of the concrete shall be struck off at the specified levels shall be furnished and finished rough.

3.27.5 For MonolithicFinish

Where no more finishing course is to be supplied as in the case of basement floor, industrial flooring or the screed concrete flooring etc., the concrete shall be completed and struck off at the specified levels and slopes in a screed board and then floated with a wooden float. Steel trowel ling is then started after the concrete has hardened enough to prevent the excess of fines and water to rise to the surface but not hard enough to prevent proper finishing. Troweling shall be such that the surface is flat, smooth and neatly finished.

3.28 Curing of Concrete

3.28.1 General

The purpose of curing is either to provide sufficient water at optimum temperature or to prevent loss of moisture from the concrete itself so that the cement inside the concrete is sufficiently hydrated which, of course, is a slow and prolonged process. As soon as the concrete has hardened sufficiently, the curing shall be started.

3.28.2 Different Methods ofCuring

Any one of the following may be used for curing as approved by the Engineer.

a) Curing by DirectWater

This is done either by pounding or spraying water.

Ponding

Ponding is widely used for curing slabs and pavement. Earth bands are formed over the slabs and water is pumped or poured into them and the same is replenished at interval to make up for the loss of evaporation. As this type of curing is one of the best methods, 10 days of curing after final setting is sufficient.

By Spraying Water Curing is done by spraying water by suitable means at approved time intervals. While spraying, it shall be ensured that the complete area is covered. In order to avoid cracking, cold water shall not be applied to massive members immediately after striking the form work, while the concrete is still warm.

Alternative wetting and over drying shall be avoided.

Curing by spraying water shall be continued at least for 18 days.

- a) Curing of Concrete with Absorbent Material Kept Damp The entire concrete surface is covered either with hessian, burlap, sawdust, sand, canvas or similar material and kept wet continuously for at least 12 days after finalsettings.
- b) Curing by Covering Concrete Surface with an Impressive Sheet This is achieved by covering the entire concrete surface with water proof paper or plastic sheets specially manufactured for this purpose. The waterproof papers are stuck together by adhesive compound and the plastic sheets can be welded at site. Such type of covering shall be kept at least for 24 days after the final setting. It is preferable to have sheet as white in appearance since the white colour will reflect hot sunrays and keep the concrete temperature at reasonablelevel.
- c) Curing by Providing Protective Membrane by Applying curing compound This is achieved by applying a membrane forming compound (curing compound) over the concrete surface. Generally, these are available in the emulsion form. The application of the curing compound should be started immediately after stripping off the shuttering in case of formed surface and after the surface has hardened in case of unformed surface.

The curing compound membrane forming emulsions dry up within 3 to 4 hours after application and forms a continuous coherent adhesive membrane over the concrete surface. Such membrane serves as a physical barrier to prevent the loss of moisture from the concrete itself. Membrane forming emulsions are generally coloured black or white to improve visibility for ensuring uniform application. Black colour shall never be used for curing in very hot weather. In order to prevent glare, a colouring pigment may be added to white compounds. Black curing compounds are either Bituminous or Asphaltic emulsions and shall be used to surfaces which are to be covered by back filling or on the floor which is to be covered with tiles andlinoleum.

White curing compound shall be used for the surfaces of tall structures under exposure of hot sun where other method of curing cannot be properly ensured.

d) Curing by Chemical Coating For chemical curing, sodium silicate or calcium chloride is used. The use of calcium chloride shall be done with the approval of the Engineer. Normally, the sodium silicate mixed with water is applied over concrete surface and, when it dries up, it forms a thin varnish like film, which fills up the pores, and surface voids and prevents evaporation of water. This also acts like curing compound but only difference is that curing compounds are available in ready mixed emulsion forms while sodium silicate is to be mixed with water atsite.

3.28.3 Limitation to Use of Different Methods ofCuring

i) Curing by the processes as indicated in Section B – Clause 3-24 and more specifically as per sub-clause 2(b) of the above clause gives very good results in normal warm climate for maturity of concrete. ii) In cold weather, the process as indicated in sub-clause 2(b) of clause 3-24 gives very good result for maturity of concrete. iii) Where water cement ratio is less than 0.5, the methods indicated in sub-clause 2(d) and 2(e) of clause 3-24 of Section B, shall not be used. iv) In warm climate also, where the methods of curing as indicated in sub-clauses 2(a) and 2(b) of clause 3-24 cannot be properly ensured, any suitable method of curing as indicated in subclasses 2(c) to 2(e) of clause 3-24 of Section B, as approved/directed by the Engineer, shall beadopted.

3.29 Testing of Concrete

3.29.1 General

The Contractor shall carry out, entirely at his own cost, all sampling and testing in accordance with the relevant IS standards and as supplemented herein. The Contractor shall get all tests done in an approved laboratoryandsubmittotheEngineer,thetest

resultintriplicate within 3 days after completion of the test.

3.29.2 Consistency Test (Tests of FreshConcrete)

At the place of deposition/pouring of the concrete, to control the consistency slump tests and/or compacting factor tests shall be carried out by the Contractor in accordance with IS 1199 as directed by the Engineer.

The results of the slump tests/compacting factor tests shall be recorded in a register for reference duly signed by both the Contractor and the Engineer. That register shall be considered as the property of EMPLOYER, and shall be kept by the Contractor at site in safecustody.

The results of the slump tests/compacting factor tests shall tally, within accepted variation of 12%, with the results in the respective design mix, in case of mix design concrete and with the values indicated in the table under clause 6.1 of IS:456 in case of nominal mix concrete. For any particular batch of concrete, if the results do not conform to the requirements as specified in IS 456, the Engineer has the right to reject that batch and theContractorshallremovethesameimmediatelyfromthesite, atnocosttoEMPLOYER,

3.29.3 Strength Test of Concrete

While placing concrete, the Contractor shall make six (6) 150 mm test cubes from particular batches of concrete as desired by the Engineer. The frequency of taking test cubes shall be either according to clause 14.2 of IS:456 or as directed by the Engineer.

The cubes shall be prepared, cured and tested according to IS 516. Out of the six (6) test cubes, 3 shall betested for compressive strength at 7 days after casting and the remaining 3 at 28 days after casting A register shall be maintained at site by the Contractor with the following details entered and signed by both the ContractorandtheEngineer.ThatregistershallbeconsideredasthepropertyofEMPLOYE R,

a) Reference to the specific structuralmember

b) Mark oncubes

c) The grade of concrete

d) The mix of concrete

e) Date andtime

f) Crushing strength at 7days

g) Crushing strength at 28days

h) Any other information directed by the Engineer.

3.29.4 Acceptance Criteria for TestCubes

The acceptance criteria of concrete on strength requirement shall be in accordance with the stipulations under clause 15 of IS:456.

3.29.5 Non-destructive Tests on HardenedConcrete

If there is doubt about the strength or quality of a particular work or the test results do not comply with the acceptance criteria as stipulated under clause 15 of IS:456, non-destructive tests on hardened concrete like core tests and/or load tests or other type of nondestructive tests like ultrasonic impulse test etc. shall becarriedout, as maybedirected by the Engineer, by the Contractoratentirely his owncost.

The core tests and load tests shall comply with the requirements of clause 16.6 of IS: 456.

3.29.6 Concrete Below SpecifiedStrength

In case of failure of test cubes to meet the specified requirements, the Engineer may take one of the following actions:

- 1. Reject the work and instruct that section of the works to which the failed cubes relate shall be cut out and replaced at the Contractor's expense.
- 2. Instruct the Contractor to carry out additional tests and/or works to ensure the soundness of the structure at the Contractor's expense.
- 3. Accept the work with reduction in the rate in appropriateitem.

3.29.7 Concrete failed in Non-destructionTests

In case test results of the core tests or load tests in a particular work do not comply with requirements of respective clause (16.3 for core test and 16.5 for load tests) of IS 456, the whole or part of the work concerned shall be dismantled and replaced by the Contractor as may be directed by the Engineer at no extra cost to EMPLOYER, and to the satisfaction of the Engineer. No payment for the dismantled concrete including relevant form work, reinforcement, embedded fixtures etc. shall be made. In the course of dismantling if any damage occurs to the adjacent structure or embedded item, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

3.30 EXPANSIONJOINTS

3.30.1 GENERAL

Expansion joints shall be provided where shown on the drawings or as directed by consultant. They shall be constructed with an initial gap between the adjoining parts of the works of the width specified in the drawings.

The contractor shall ensure that no debris is allowed to enter expansion joints Expansion joints shall be provided as per drawings. Contractor shall ensure that expansion joints are made water-tight and that no leakage occurs through these joints for which he shall be responsible to redo at his own cost.

3.30.2 OPEN JOINTFILLERS

Where shown on the drawings, open joints in the structure shall be filled with joint fillers. The joint filler shall be easily and uniformly compressible to its original thickness, tampable, easily cut or sawn, robust, durable, resistant to decay due to termite or weathering, unaffected by water and free of any constituent which will bleed into or stain the concrete.

The joint filler shall be of same thickness of the joint width, it shall extend through the full thickness of the concrete unless otherwise specified and shall be sufficiently rigid during handling and placing to permit the formation of straight joints

3.30.3 JOINT SEALINGCOMPOUNDS

Joints sealing compounds shall seal joints in concrete against the passage of water prevent the ingress of grit orother foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete shall have good extensibility and adhesion to concrete surfaces and shall have resistant to flow and weathering. Poly-sulphide joints where specified on the drawings shall be seated with poly-sulphide liquid polymer, stored, mixed handled, applied and cured strictly in dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturer's written instructions prior to sealing. The Contractor shall use only competent personnel experienced in the application of poly-sulphidefor suchwork.

Where specified in the drawings, rubber/bituminous based sealant shall be of an approved manufacturer. The treatment of the joint and the use of sealing

compound shall be strictly in accordance with the manufacturer's written instructions.

3.30.4 WATERBARS

Where water bars are shown on the drawings, the joints shall incorporate an approved PVC external type water-bar complete with all necessary molded or prefabricated intersection pieces assembled in accordance with the drawings with bends and butt joints in running lengths made by heat welding in an electrically heatedjig.

Jointing and fixing of water-bars shall be carried out strictly in accordance with the manufacturers written instructions.

The water-bars shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete.

Where reinforcement is present adjacent to water-bars, adequate clearance shall be left between the reinforcement and water-beds to facilitate of the concrete.

3.31 CRACKS

If any cracks develop in the reinforced cement concrete construction which in the opinion of the Consultant may be detrimental to the strength of the construction, the contractor at his own expense shall test the structural element in question If under these test loads the cracks shall develop further the contractor at his own expense shall dismantle the construction, cart away the debris, replace the construction and carry out all consequential work there to at no extracost.

If the cracks are not detrimental to the stability of the construction in the opinion of the Consultant, the contractor at his own expense shall grout the cracks with pneumatically applied mortar. At his own expense and risk, he shall also make good all other building works such as plaster, molding, surface finish of floods, roofs, ceiling etc. which in the opinion of the Consultant have suffered damage either in appearance or stability owing to suchcracks.

The repair work shall be carried out to the satisfaction of the Consultant/Project-incharge. The decision of the Consultant/Project-in-charge as to the extent of the liability of the contractor in the above matter shall be final and binding on the contractor.

3.32 SUPERVISION

All concreting work shall be done under strict supervision of the qualified and experienced representatives of the Contractor as well as those of the Consultant The contractor's Engineer and supervisor who are in charge of concreting work shall be skilled in this class of work and shall personally supervise all the concreting operations.

Special attention shall be paid to the following: -

- (a) Proportioning, mixing and quality testing of the materials with particular control on the water cementratio.
- (b) Laying of material in place and thorough compaction of the concrete to ensure solidity and freedom from voids and honeycombing.

- (c) Proper curing for the requisiteperiod.
- (d) Reinforcement and inserts/embodiments position are not disturbed during concreting and consolidation byvibration.

3.33 QUALITYCONTROL

The Consultant/Project-in-charge reserves the right to make changes in the mix proportions including the increased cement content or/and a change in the Contractor's control procedure, should the quality control during progress of the works prove to be inadequate in his opinion. All the concrete work shall be true to level, plumb and square within the acceptable tolerance. The corners, edges and rises in all cases shall be unbroken and finished properly andcarefully.

3.34 TOLERANCES

The acceptable tolerances for formed concrete surfaces shall be given below: -

- a) Variation from plumb for
 - i. Columns and walls to be rendered 6 mmin 3 meters
 - ii. Exposed columns and walls 3 mm in 3 meters
- b) Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls: 6 mm & + 12mm

All the works executed beyond the tolerance limits are liable to be rejected and no extra cost shall be paid to the contractor for reconstructing the same as desired by the Consultant/Project-in-charge.

3.35 TESTINGROOM

A testing room of not less than 10 sqm equipped with the following apparatus and qualified concrete technician, labour and materials required for carrying out tests therein shall be provided by the contractor at hisowncost:

- Sieve Set (For aggregate 20 mmdown)
 40 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 4.75 mm, 600-micron, 300 micron, and 75 microns having diameter of 45 cms.
- 2. Weighing
- a) Physical balance cap. 200 gmswith weigh box (accuracy 0.5gm)
- b) Counter Scale cap 20Kg
- c) Weights
 - 5 kg 1No 500gms 1 No. 2kg 2Nos. 200gms 1 No.
 - 1 kg 1 No. 100 gms 1 No.
- 3. SlumpCones 2Nos
- 4. 15 cmsmoulds 18no.
- 5. Electric/KeroseneHeater
- 6. Pans etc. as directed by the Consultant
- 7. Measuring Cylindersof 1000 ml., 500 ml and 100ml.
- 8. Wash bottles of the Capacity of 500 ml., 2Nos.

- 9. Sink
- 10. Workbenches, shelves, desks and any other furniture and light ingasrequired by the Consultant.
- 11. Spring balance dial type cap. 100kg
- 12. Litremeasures
 - a) 10 Lit 1 No.
 - b) 5 Lit 1No.
 - c) 2 Lit 2Nos
 - d) 1 Lit 1No. e) 1/2 Lit 1No.
- 13. Cube Testing Machine 100Tons.
- 14. Oven.
- 15. Cores/ Apparatus for conducting Proctor DensityTests.

3.36 CO-ORDINATION OFWORK

The contractor is fully responsible for coordinting with the other agencies for sanitary, electrical work, etc. to ensure execution of their work related to commencement of concreting. Nothing extra shall be payable to the contractor, if the works pertaining to concreting have to be dismantled and redone due to lack of coordination on the part of the contractor in ensuring completion of works of such agencies before concreting had been undertaken.

4 SPECIFICATIONS FOR STEELREINFORCEMENT

4.1 GENERAL

4.1.1 DESCRIPTION

This section covers the requirements for fabricating, delivering and placing of steel reinforcement in position for casting all types of concretework

4.1.2 RELATED WORK SPECIFIEDELSEWHERE

Applicable Codes and Standards:

Thecodesandstandardsgenerallyapplicableto theworkin these sectionsarelisted below:- IS: 280 Mild wire for general engineeringpurpose

IS: 432 Part I Mild steel and medium tensile steel bars Part II Hard drawn steel wire IS: 456 Code of practice for plain and reinforcedconcrete

- IS: 1139 Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concretereinforcement
- IS: 1566 Hard drawn steel wire fabric for concretereinforcement

IS: 2502CodeofPracticeforbendingandfixingofbarsforconcretereinforcement The following clauses are intended to amplify the requirements of the reference documents listed above and the contractor/Project-in-charge shall comply with these clauses.

4.2 SUBMITALS

4.2.1. BAR BENDINGSCHEDULE

The Contractor shall prepare Bar Bending Schedule for reinforcement before fabrication

4.3 MATERIALS

4.3.1 STEELREINFORCEMENT

Steel reinforcement to be procured by the Contractor for works shall be either of the following types: -

(a) MildsteelofGrade1testedqualityconformingtolS:432-Part-_

(b) 3370Codeofpracticeforconcretestructures for(PartItolV)thestorageofliquids (c) High yield strength cold worked deformed steel bars of tested quality conforming to IS: 1786 or hot rolled hightenssiledeformed steelbars oftestedqualityconformingtolS:1139.

(d) Hard drawn steel fabric conforming to IS:1566.

(e) Where galvanized reinforcement is specified in the drawings, the bars or mesh shall be hot-dip galvanized after bending generally in accordance with IS: 2629 and IS: 4759. Galvanized reinforcement shall be coated with a layer of zinc nowhere less than 0.05 mm inthickness.

All reinforcement shall be stored horizontally above ground level on supports, skids or other approved supports, clear of any running or standing water. Contact with soil should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.

Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned of rust, dust, grease and other objectionable substances. In order to confirm the quality periodical tests as specified as the relevant IS shall be conducted by the contractor at his own cost.

4.3.2. **BINDINGWIRE**

Binding wire shall be black annealed steel wire conforming to IS: 280 and of minimum 18 gauge.

4.3.3. WELDINGELECTRODES

Electrodes used for welding of steel bars shall be of ordinary mild steel grade electrodes conforming to IS: 814 and shall be of the best quality approved byConsultant/Project-in-charge.

4.4 STORAGE

Reinforcement steel shall be handled and stored in a manner that bending or distortion of the bars is avoided and contamination of steel is prevented.

All reinforcement shall be stored horizontally above ground level on supports, skids or other approved supports, clear of any running or standing water Contact with soil should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion Bars of different classifications and diameters shall be stored separately A record shall be kept of the batch numbers of reinforcement

deliveries in such a form that the part of the works in which particular reinforcement is used can be readily identified. Welding electrodes shall be stored in moisture control-led environment in accordance with the manufacturer's recommendations.

4.5 **FABRICATION**

Reinforcement steel shall be carefully and accurately cut, bent or formed to the dimensions and configurations shown on the drawings and as per bar bending schedules approved by the Consultant / Project- in-charge. All reinforcement shall be bent cold using appropriate pin size. Bars may be preheated only on approvaloftheConsultant.Quenchingshallnotcoolhotbars.

BendsshallbeingaccordancewithIS:2502.

It shall be ensured that the bars are not straightened in any manner that will injure the material. Any bars incorrectly bent shall be used only if means for straightening and rebinding be such as not to affect adversely the material. Reinforcement shall not be re-bent or straightened without prior review by the Consultant. No reinforcement shall be placed in position on the works without approval of the Consultant, whether or not it is partially embedded in hardened concrete.

Reinforcement steel having a reduced section, visible transverse cracks in bends, or otherwise damaged in anyway shall not be used.

Spiral reinforcement shall be accurately fabricated to the diameter and pitch shown on the drawings. One- and one-half finishing turns shall be provided at both top and bottom unless shown otherwise. Cut ends of galvanized rods shall be given a protective coat of an approved zinc paint immediately after cutting.

4.6 LAPPING

As far as possible bars of maximum length available shall be used. All bars shall be in one length unless otherwise shown on the drawings or agreed with the Consultant/Project-in-charge.

Laps shown on the drawings or otherwise specified by the Consultant shall be based on the use of bars of maximum length by the contractor. In case the Contractor wishes to use shorter bars, laps shall be provided at the Contractor's cost in the manner and locations approved by the Consultant /Project-in-charge.

Not more than 1/3 rd. of the bars or as specified in the drawings shall be lapped at one section.Reinforcement bars shall not be welded unless shown on the drawings or instructed by the Consultant / Project-in-charge.

4.7 PLACEMENT

All reinforcement shall be placed accurately and maintained in the position indicated on the drawings. The contractor shall provide approved type of supports for maintaining the bars in position and ensuring required spacing and correct

Cover of concrete to the reinforcement as called for in drawings. Pre-cast cement concrete blocks of required shapes and size, MS. chairs and spacers bars shall be used in order to ensure accurate positioning of reinforcement. Pre-cast concrete blocks shall be cast well in advance and shall be at least equal in quality to the class of concrete specified in the work.

In fair faces of concrete, temporary spacers only shall be used and removed or withdrawn as compaction of concrete proceeds. Spacers will not be permitted to be left in fair faces of concrete.

All intersections of the reinforcements shall be securely tied with two strands of binds wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.

Tack welding of crossing bars shall not be done except as authorized or directed by the Consultant / Project- in-charge. Nothing extra will be paid for tack welding.

The contractor shall take all responsible precautions to ensure that when handling or erecting reinforcement no damage shall be done to finished concrete. Bars that are partially embedded in concrete shall not be filed bentunlessconcurrencehasbeenobtainedfromtheConsultant/Project-in-charge.

Walkways and borrow runs for placing and compacting the concrete shall be independent of the reinforcement.

Loose binding wire and other extraneous metal shall be removed from inside the form work prior to concrete placing.

Without relieving the Contractor of the responsibilities for the correctness thereof, the reinforcement shall be inspected and approved by the Consultant in writing before any concrete is placed and the contractor shall allow sufficient time for such inspecting and any subsequent remedial action to be carried out No part of the reinforcement shall be used for conducting electrical currents.

4.8 COVER TOREINFORCEMENT

Unless shown otherwise on the drawings, minimum cover for all reinforcement shall be provided as per IS: 456, care shall be taken to maintain the correct cover to reinforcement.

For concrete members exposed to weather, earth, action of harmful chemicals, acid vapor, saline atmosphere, sulphureous smoke etc. minimum cover for reinforcement shall be increased by 15 cm to 40 mm as directed by the Consultant / Project-in-charge.

The maximum cover for reinforcement shall not be greater than that specified above or shown on the drawings plus 10 mm except for bundledbars.

For bundled bars, minimum, concrete cover shall be equal to the equivalent diameter of the bundle but need not be greater than 50mm.

Exposed reinforcement intended for binding with future extensions shall be protected from corrosion as shown in thedrawings.

4.9 CLEANING

After placing, the reinforcement shall be maintained in a clean condition until the concrete is placed. On no account the bars shall be oiled or painted or mould oil used on the formwork be allowed to come in contact with thebars.

Before concreting is commenced, the bars shall be thoroughly cleaned with dry gunny bags if they are coated lightly with rust or other impurities.

4.10 WORK WILLINCLUDE

- a) All cutting to lengths, labour in bending and cranking, forming hook ends, handling, hoisting and all that is necessary to fix reinforcement in work as per Drawings and specifications This shall also include all that is fairly intended and is necessary for completion of work.
- b) Cost of pre-cast concrete cover blocks to maintain cover and holding reinforcement in position, chairs, spaces, dowels, pins, laps, etc.
- c) For fabricating and fixing reinforcement in any structural member irrespective of its location, dimension and level.
- d) Work at allevels.
- e) All the above-mentioned works shall be included in the quoted rates Nothing extra shall be payable to the contractor on thisaccount
- f) ReinforcementSteelprocurementshallbedonebytheContractor.

5 SPECIFICATIONS FORFORMWORK

5.1 GENERAL

5.1.1 DESCRIPTION

This section covers the requirements for providing, fabricating and erecting of form work including propping, bracing, shoring, strutting, rising, bolting, wedging and all other temporary and all other temporary supports to the concreted uring the process of setting subsequent removal of forms.

5.1.2 RELATED WORK SPECIFIEDELSEWHERE

a. Cast-in-place ReinforcedConcrete

5.1.3 APPLICABLE CODES ANDSTANDARDS

The codes and standard sgenerally applicable to the work of this section arelisted hereinafter IS:456Code of practice for plain andreinforced concrete.IS:4990Ply wood for concreteshuttering work.

5.2 SUBMITTALS

5.2.1 TYPE OF FORMWORK

Prior to start of delivery of material for formwork, the contractor shall prepare samples of different types of formworks for about 10 sqm and obtain approval of the Consultant/Project-in-charge.

5.2.2 DESIGN OFFORMS

Before fabricating of forms, the contractor shall submit design calculations for proposed form work to Consultant/Project-in-charge for his approval However, the approval of his responsibility for adequately constructing and maintaining the forms so that they will function properly.

5.2.3 TIEBOLTS

In case the contractor proposes to use tie bolts running through the concrete, the location and size of such tie bolts shall be submitted to the Consultant/Project-incharge for his Approval.

5.3 MATERIALS

5.3.1 Formwork shall be timber, plywood, steel or any other material capable of resisting damage to the contact faces under normal conditions of erecting forms, fixing steel and placing concrete. The selection of materials suitable for formwork shall be made by the Contractor based on the maximum quality consistent with the specified finished andsafety.

5.3.2 TIMBER

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and into liable to warp when exposed to sun and rain or wetted duringconcreting.

5.3.3 PLYWOOD

Plywoodusedforformworkshallbe12mmthickshutteringqualityplywoodcomplyingwit hIS: 4990andof make approved by theConsultant

5.3.4 STEEL

Steel form work shall be made of minimum 2 mm thick or more as required black sheets stiffened with angle iron frame made out of M S angles 40 mm X 6mm.

5.4 **DESIGNCRITERIA**

Formwork shall be designed for the loads and lateral pressures due to dead weight of concrete, superimposed live loads of workmen, materials and plants and for other loads as indicated on the drawings. Forms shall be designed to have sufficient strength to carry on the hydrostatic head of concrete as a liquid without deflection tolerances exceeding the acceptablelimits.

Where necessary to maintain the tolerances indicated on the drawings. The formwork shall be cambered to compensate for anticipated deflections due to the weight and pressure of the fresh concrete, and also due to anyotherconstructionloads.

Unlessotherwiseshownorspecified, the cambershall be provided as below: -

Types of members	Compression As % of tensil	n Steel e steel	Camber Co-
Simple span	0%		0.06
Continuous	50%		° 0.03
span Cantileve	r0%		0.03
Curmever	50%		0.02
	0%		0.08
	50%		0.04
Camber incmsWhe	re	(K X L X2.54)/	° D
K= L= D=		Cambercoe Length of me Depth of me	fficient ember inmeter mber inmeter

5.5 **ERECTION OFFORMWORK**

Forms shall be used wherever necessary to confine the concrete during vibration and to shape it to the required line. The formwork shall conform to shapes, lines, levels and dimensions of the concrete sections shown on thedrawings.

Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of concrete and shall be maintained rigidly in position. Form work shall be adequately supported by adequate number and size of struts, braces, ties and props to ensure rigidity of forms during concreting. Where props rest on natural or filled up ground, to avoid any settlement, the soil shall be thoroughly compacted and bases of props shall be sufficient size so as to restrict the bearing on the ground to 50 t/ sqm Forms shall be tight enough to prevent loss of mortar from the concrete and to produce dense, homogenous and uniformlycolored concrete completely free from honeycombing or surface roughness. Joints in formwork shall be designed to prevent leakage, not only between individual elements forming the panels but also from the horizontalandverticaljunctionbetweenthepanelsthemselves.

If form work is held together by bolts or wires, those shall be so fixed that no reinforcement bar is exposed on surface against which concrete is to be laid. The Consultant may at his discretion allow the contractor to use tie bolts running through the concrete at his owncost. Hole left in the concrete by these tie-bolts shall be filled as specified by him at the Contractor's expense. Formwork shall be constructed so as to facilitate loosening and permit removal without jarring the concrete Wedges, clamps and bolts shall be used wherever practicable instead of nails. All formwork erected shall be approved by the Consultant/Project-in-charge before concreting is started.

5.6 CLEANING AND OILING OFFORMS

At the time concrete is placed in the forms, the surface of the forms in contact with the concrete shall be free from encrustations of mortar, grout or other foreign materials. Temporary openings shall be left at the bottom of formwork to enable, sawdust, shavings, wire cuttings and other foreign material to be worked out form the interior of the forms before the concrete is placed.

The surface of the forms to be in contact with the concrete shall be coated with an approved coating that will effectively prevent sticking and will not stain the concrete surfaces. After each use the surfaces of forms in contact with concrete shall be cleaned, well settled and treated with form oil approved by the Consultant Project-in-charge. Lubricating (machine) oils shall not be used.

Oiling shall be done before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in positions.

Immediately before concreting is commenced the formworks shall be carefully examined to see that all dirt, shavings, sawdust and other refuse have been removed and the formwork shall be wetted thoroughly to prevent absorption of water from concrete. The formwork shall be kept wet during concreting and for the whole time that it is left inplace.

5.7 **REMOVAL OF FORMWORK**

Form works shall be removed carefully so as to prevent damage to the concrete. Wooden wedge only shall be used between the concrete surface and the form where force is necessary to separate the form from the concrete. Metal wedge, bars or tools shall not be used for this purpose. Any concrete damaged in the process

of removing the forms shall be repaired in accordance with the provision of concrete specifications.

Unless otherwise permitted by the Consultant, the forms shall not be stripped in less than the minimum periods specified in IS: 456. However, the Consultant may increase the above period if he considers it necessary for structural stability

All non-supporting forms shall be loosened and removed during regular working hours, and as soon as the concrete has hardened sufficiently to prevent damage from the removal of the forms All false work and forms supporting concrete beam and slabs, or other members subject to direct bending stress, shall not be removed or released until the concrete has attained sufficient strength to ensure structural stability and to carry both the deadandliveloadsincludinganyconstructionloadswhichmaybeplaceduponit.

No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshared portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads Form work shall be removed in such a manner so as not to impair safety and serviceability of the structure It shall be removed gradually to prevent sudden application of loads to the concrete All concrete to be exposed shall have sufficient strength to prevent any damage caused by removal of formwork.

5.7.1. HACKING:

Immediately after removal of forms, the concrete surface intended to be either plastered or finished, shall be roughened with brush hammer or with chisel and hammer as directed by the construction manager tomake thesurfacesufficientlycoarseandroughtoprovideabondingkeyforplaster.

No extra payments shall be made to the Contractor for such work on concrete surface after removal of the form work. No payment shall be made for temporary formwork used in concreting, or for form work required for joints or bulk-heads, in floor or elsewhere, whether such joints are to be covered later with concrete or mastic or othermaterials.

5.7.2. POCKETS ANDOPENINGS:

Where boxes, pockets or openings are required (not exceeding 0.1 sqm) to be formed in the concrete. No deduction shall be made for the area of box or pockets in measuring the area of concrete surface shuttered. In other words, the area of shuttering shall be reckoned as if box of pocket or openings were not present.

However, on measuring the concrete quantity, the volume of the box or pocket shall be deducted. If the area of box or pocket or openings against the shuttered faces exceeds 0.1 sqm. It shall be paid not as a box or pocket or opening but as formwork at the rates forformwork.

No extra payment shall be made for holes to be made in the form work for inserting electrical conduits hooks for fans etc.

5.8 **REUSE OFFORMS**

Immediately after the forms are removed, they shall be cleaned with jet of water and a soft brush before they are reused.

The contractor shall not be permitted reuse of any forms which in the opinion of the Consultant has worn out and has become unfit for formwork.

The Consultant/Project-in-charge may in his absolute discretion, order rejection of any forms he considers unfit for use in the works, and order their removal from the site.

6 SPECIFICATIONSFORBRICKMASONRYWORK: -

6.1 SCOPE: -

The Contractor shall provide all labour, materials, scaffolding operations, equipment and incidentals necessary required for the completion of all brickwork called for in the drawings and documents and that which is fairly intended for smooth completion of thework.

6.1.1 BRICKS (CLASS50): -

The bricks shall be well burnt locally available from good brick earth and shall be of uniformsize (6"x 4.5"x3") unless otherwise specified They shall be of uniform deep red, cherry or copper colour, thoroughly well burnt without being verified and regular inshapes.

6.1.3 MORTARS: -

All brick work shall be laid with specified mortar of good workable consistency.

6.1.4 SOAKING OFBRICKS: -

All bricks required for masonry in cement or composite lime mortars shall be thoroughly soaked in clean water for at least one hour in advance of sufficient quantity size for immediate use. The cessation of bubbles whenthebricksareimmersedinwaterisanindicationofthorough soakingofbricks.

6.1.5 LAYING: -

- a) Bricks 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 thewalls.
- b) The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and all vertical joints join shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. The thickness of brick courses shall be kept uniform and for this purpose straight edge with graduations showing the thickness of each brick course including joint shall be used. Bricks shall be laid with frogsupwards.
- c) The walls of a structure shall be carried up regularly and nearly at one level and no portion of the work shall be left more than 3 ft. below the rest of the work. Where this is not possible the work shall be raked back accordingtobond (and not left too the d) at an angle not 0 exceeding 45°.
- d) All iron fixtures pipes, outlets of water, holdfasts of doors and windows, etc., which are required to be built in walls, shall be embedded in cement mortar or in cement concrete as specified, in their correct positions as the work proceeds. Nothing extra shall be paid for such extra cement mortar or of the nature statedabove.

6.1.6. JOINTS: -

Bricks shall be so laid that all joints are quite full of mortar. The thickness of the bed joints shall in no case exceed 3/8", unless otherwise specified. The face of joints shall be raked to a minimum depth of 0.5" by raking tooldaily during the progress of work when the mortar is still green, so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face of brick work shall be cleaned daily and all mortar dropingsremoved.

6.1.7 BRICK-IN-EDGECOPING

The top course of all plinths, parapets, steps and tops of walls below R C.C. slabs or beams shall be laid with brick on edge, unless otherwise specified Proper care shall be taken that the bricks forming the top corners andendsofwallsshallbeproperlyradiateandkeyedintoposition.

6.1.8. CURING: -

Green Work shall be protected from rain by suitable covering Brick Masonry with cement or composite mortar shall be kept constantly moist on all faces for a minimum period of 7 (Seven) days. In caseof fat lime mortar, curing shall commence two days after the laying of masonry and shall continue for 7 (seven) days

6.1.9 SCAFFOLDING:

Double scaffolding having two sets of vertical supports shall be provided thesupports shall be sound and strong Tied together with horizontal pieces over which the scaffolding planks shall be fixed. In building up to two stories, single scaffolding shall be allowed in this case, the inner end of the horizontal scaffolding pole shall rest in a hole provided in the header course only. Only one header or each pole shall be left out. The holds left in masonry work for supporting the scaffoldings shall be filled and made good, before plastering. The Contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to comeupon it.

WATER-PROOFING FORROOF

The waterproofing shall be integral cement-based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc. consisting of following operations:

- a) Applying and grouting a slurry coat of neat cement using 2.75 kg/sqm. of cement admixed with proprietary water proofing compound conforming to IS: 2645 over the RCC slab including cleaning the surface beforetreatment.
- b) Laying cement concrete using FULL SIZE "DAULATABAD" BRICKSwith 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of mix 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 300mm height including rounding of junctions of walls andslabs.
- c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS:2645.
- d) Finishing the surface with 20mm thick jointless cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing

compound conforming to IS: 2645 and finally finishing the surfacewithtrowelwithneatcementslurryandmakingof300x300mmsquare.

e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Project-in-charge.

With average thickness of 120mm & minimum thickness at khurra as 65mm.

9.1 GUARANTEE

The treatment shall carry a guarantee for 10 years against leakage of water, dampness, seating and other defects. The treated roof shall be tested by allowing water to stand on the areas to a depth of 150 mm for at least 72 hours. All guarantee shall be furnished in the format approved by the Consultant/Project-in-charge duly signed by the contractor and sub-contractor.

9.2 SPECIFICATIONS FORCURING

The finished surface shall be cured for at least 7 days

9.3 KHURRAS

The Khurras shall be constructed before the brick masonry work in parapet wall is taken up, and it shall be 5 cm x 45 cm and shall be formed of cement concrete 1:2:4 (1 cement: 2 coarse sands: 4 graded stone aggregate20mmnominalsize) unless sotherewisespecified in the drawings.

9.4 LAYING

A PVC sheet 1M X 1M X 400 micron shall be laid under the khurras and then cement concrete shall be laid over it to a minimum thickness of 3 cm with its top surface lower than the level of adjoining roof surface as approved.

9.5 FINISHING

The khurras and sides of the outlet shall then be rendered with cement plaster of mix and thickness stipulated in the drawings. This shall be done when the concrete is still green and shall be finished with a floating coat of neat cement The sides of the khurras and sizes of finished outlet opening shall be as directed by the Consultant.

10 SPECIFICATION FOR PLASTERINGWORK

10.1 SCOPE

The Contractor shall furnish all labour, materials scaffolding, equipment, tools, plants and incidentals necessary and required for the completion of all plaster work.

10.2 GENERAL

PlasterashereinspecifiedshallbeappliedtoallinternalsurfacewerecalledforAllplaster workshallbeexecutedbyskilledworkmeninaworkmanlikemannerandshallbeofthebes tworkmanshipandinstrictaccordancewiththedimensionsondrawingssubjecttotheap provaloftheConsultant/Engineer-incharge. The primary requirement of plaster work shall be to provide dense, smooth and hard enclosure and devoid of any cracks of the interior and/or exterior.

10.3 SCAFFOLDING

Double scaffolding having two seats 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. The contractor shall get the scaffolding approved from the Consultant well in advance.

10.4 CHASING ANDBREAKAGE

Fixing of door and window frame, shall be completed before any plaster work is commenced on a surface. No chasing or cutting of plaster shall be permitted normally. However, if the same is felt unavoidable at places, written permission shall be obtained from the Consultant before cutting any such plaster. Broken corners shall be obtained from the Consultant before cutting any such plaster, Broken corners shall be cut back out less than 150 mm on sides and patched with cement mortar as directed. All corners shall be rounded to a radius of 80 mm or as directed by theConsultant.

10.5 PREPARATION

Masonry and concrete surfaces which call for application of plaster shall be clean, free from dust and loose mortar. Efflorescence if any shall be removed by brushing and scrapping. For masonry surfaces the joints shallbe raked out properly, while the concrete surfaces shall be roughed by wire brushing and hacking to provide the key, thereby ensuring proper bond to the satisfaction of the Consultant. The surface shall then be

thoroughwashedwithwater, cleaned and keptwet before plastering is commenced.

10.6 CHICKEN WIREMESH

Galvanized chicken mesh (22-gauge, 12 mm size) shall be provided at junctions of brick masonry and concrete members, to be plastered and other locations as called for, properly stretched and nailed with galvanized wire nails, ensuring equal thickness of plaster on both sides of the mesh. The width of the mesh shall be as approved by the Consultant / Project-in-charge. The chicken mesh wherever. Specified, shall be fixed in place beforeplastering.

10.7 Samples of each type of plaster shall be prepared well in advance of undertaking the work for the approval of the Consultant/Project-in-charge

11.8.1 **MORTAR**

Themortar of the specified mixshall be used Mortarshall be prepared as specified under" Brick Work It shall be made in small quantities, as required, and applied within 15 minutes of adding water to the plaster mix

11.8.2 CEMENT:Cement shall be as per specifications under "Concrete Work"

11.8.3 WATER:Water shall be as per specifications under "Concrete Work"

11.8.4 SAND

For plaster work normally clean fine river sand shall be used. However, if specified in the drawing or schedule of finishes, coarse sand conforming to the specifications under Concrete work" shall be mixed with fine river sand in proportion specified or directed by theConsultant.

11.8.4 WATER PROOFINGCOMPOUND

FOSROC, ROFFE Sika Chemicals or approved equivalent as approved by Consultant / Project-in-charge wherever specified.

11.9. CEILINGPLASTER

6mm thick Ceiling plaster shall be completed before commencement of wall plaster. Plastering shall be started from the top and worked down towards the floor. To ensure even thickness and true surface, plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 meters intervals over the entire surfaceto the plaster to serve as gauges. The surface of these gauged areas shallbe truly in place of the finished plaster surface. The mortar shall be laid between thegaugeswith a trowel ensuring through filling of joints. The mortar shall be applied in a uniform surface slightly more than the specified thickness and then brought to a true surface, by working a wooden straight edge reachingacrossthegauge, withsmallupwardandsidemovementsat time. Finally, the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy aranular texture is required. Excessive trawling or over working the float shall be avoided.All corners, arises angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, junctions etc. Where required shall be done without any extra payment. Such rounding shall be carried out with proper templates to the sizes required. No portion of the surface shall be left out initially to be patched up late on. Grooves shall be provided at the junction of ceiling and wall plaster without any extracost.

In suspending work at the end of the day, plaster shall be left, cut clean to line both horizontally andvertically. When recommencing the plastering, the edge of the old work shall be scraped, cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to be properly joined together. Plastering work shall be closed at the end a of day on the body of the surface and not nearer than 15 cm to any corners or arises. It shall not be closed on the body of the features such as pilasters, bands and cornices. Horizontal joints in plaster work shall not also occur on parapet tops and copings, as these invariably lead toleakages.

11.9.1 GROOVES

Wherever directed all joints between concrete and brick masonry besides other locations as called for shall be expressed by a groove cut in plaster at no extracost

11.9.2 FINISH

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required the work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long andwith plumb bobs All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the workproceeds.

11.9.3 CURING

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from alldamages

11.9.4 **PRECAUTION**

Any cracks which appear in the surface and all portions, which sound hollow when tapped or are found to be soft or otherwise defective shall be cut out in rectangular shape and redone as directed by the Consultant

11.9.5 FLOATING COAT OF NEATCEMENT

Where finishing with a floating coat of neat cement is specified in the drawings or directed by the Consultant, specification, for this item of work shall be same described above except for the additional floating coat which shall be carried out as below. When the plaster has been brought to a true surface with the wooden straight edge, it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coatshall 1 kg. per sq.mt. smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plastermix.

11.10 BEARINGPLASTER

This shall be consist of cement plaster 1:3(1 cement: 3 coarse sand) 20 mm thick finished with a coat neat cement laid on top of walls as bearing for RCC lintels, beams and slabs. When dry, a thick coat of lime wash shall be given.

12.1 ACRYLICCOPOLYMERAGGREGATEFINISH

12.1.1 Material

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, water proof coating.

12.1.2 Preparation of Surface

The surface to be coated shall be cleaned and all dirt, dust, grease and loose particles shall be removed. Any old textures surface shall be removed with removing agent as per manufacturer's instructions.

12.1.3 Application

Bonding agent and water shall be mixed first. Then the flakes / granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be leftfor20-30 minutes before starting application. The bonding agent, flakes / granules and water shall be mixed in different ratiosfordifferent finishes as per manufacturer's specifications.

The first application shall be by steel trowel. It shall be smoothened, if the specified finish required, by a plastic trowel.

LISTOFAPPROVEDMAKES/AGENCYOFMATERIALS (FOR CIVIL WORK)

The following guidelines are to be noted with regard to use of materials in the work.

1. The CONTRACTOR shall be required to use material of the make given in the list of approved make or specifically mentioned in the Bill of Quantities. EMPLOYER is free to demand the CONTRACTOR to use anyparticularmakefromtheapprovedlistofitems.

However, in case of non-availability of any item as per the list of approved make CONTRACTOR shall use alternative item of ISI make with prior written permission from the CONSULTANT/Project-in-charge.

- 2 Wherever, material bearing Standard Mark (ISI) are used in the work, the Contractor should furnish necessary documents and proof of payments made for the procurementof materials bearing Standard Mark (ISI).
- 3. In case it is established that Standard material (bearing ISI mark) as well as the materials indicated in the list (asmentioned in heabovepara)arenot available in the market, then approved equivalent materials may be used in the worksubject to approval from the consultant and Project in-charge.
- 4. For materials bearing "Standard Mark (ISI)" ordinarily no testing is to be done. However, in case of doubt or witha viewtocheckthequalityofmaterials, Project-inchargemaysendsamples forrandomtesting.
- 5. For use of materials other than materials bearing "Standard Mark (ISI)" Mandatory tests shall be conducted at the frequency specified in the contract. In case frequency of testing is not stipulated in the contract then standardspecification(CPWD,ISIetc.)maybeconsideredforfrequencyatwhichmateri alsaretobetested.
- 6. Before bulk purchase of quantities of materials, it is the responsibility of the Contractor to get the samples of materials approved from consultant andProjectin-charge

SI. No.	MATERIALS	APPROVED MAKE/APPROVED AGENCY
1.	Antitermiteemulsifiable concentrate	As per CPWD/PWD specifications and ISI marked
2.	Damp proof materials / water proofing compound	Impermo, Duraseals, Acco-proof, CICO etc., Duraseed, STP, GE Silicon, Pidilite. Fosroc, Sika
3.	Reinforcement steel	Rajuri, Kalikaas approved (Primary manufacture)
4.	Structural steel section	To be defined at later stage
5.	Portland Slag cement	Ultratech, Ambuja as per I.S. 455 as approved

6.	White cement	JK white, Birla white
7.	AAC Blocks	Siporex, Biltech, Magicrete, with thicknesses as mentioned in the BoQ
8.	Red Bricks for Construction	From Parali, Maharashtra. Thickness as mentioned in BOQ, meeting standard quality norms,
9.	Red Brick for Brickbatt Waterproofing	'Daulatabad' well burnt 225x110x75mm well burnt bricks, meeting standard quality norms.
10.	Wire mesh	Sterling Enterprises, Trimurty welded mesh
11.	Bitumen	Indian oil, Hindustan petroleum, Bharat Petroleum
12	Chemical Impregnated Water Proofing / Brickcoba Water Proofing Agencies	ROFF, SIKA, FOSROC.

<u>16.</u> <u>LISTOFDOCUMENTS/REGISTERSTOBEMAINTAINEDATSITEFORENSURINGPROPER</u> <u>QUALITY CONTROL OF WORKIN PROGRESS</u>

- 1. A complete set of ContractDocuments.
- 2. Acompletesetofdrawings(TenderdrawingsandGoodforExecutionDrawings).
- 3. A complete set of change in specification or scope ifany.
- 4. MaterialTestRegister(MasterRegister)indicatingdetailsofvariousotherTestRegisters.
- 5. Cement TestRegister.
- 6. Aggregates TestRegister
 - i) Fineaggregate-sand
 - ii) Coarseaggregate
- 7. Cube TestRegister
- 8. Register for anti-termite material used in thework.
- 9. Register for bricks testing..
- 10. Bar bending schedule Register/PourCards.
- 11. Concrete PouringRegister.
- 12. Paint TestRegister.
- 13. Register for approval of samples for various materials.
- 14. Site OrderBook.
- 15. Register showing use of non-specified materials and reasonsthereof.
- 16. HindranceRegister
- 17. Cement & steel consumption register.
- 18. Levels-Record registers (for earth filling,roadwork).
- 19. Daily records pertaining to labourdeployment.
- 20. Recordsforallthedeviationsduringtheexecutionofworktobemaintained.
- 21. Records for bitumen consumptionregister.

- 22. Paint consumptionregister.
- 23. Water proofing compound consumptionregister.
- 24. MeasurementBook

<u>APPENDIX – I</u>

RUNNING BILL FORMAT

i.	Nameofwork	:
ii.	NameofEmployer	:
iii.	NameofContractor	:
iv.	Accepted contractamount	:
v.	DateofCommencement	:
vi.	Stipulated dateof Completion	:
vii.	Actual dateof completion : (applicable for final bill only)	
viii.	Extension,ifany.	:
ix.	Insurance validupto	:
a)	Workmen Compension Act	
b)	Contractor'sallrisk comprehensive insurance poli	: cy
х.	Labour License No.anddate and valid upto	:
xi.	Serial No. ofthisBill	:
xii.	No. & Date ofpreviousBill	:
xiii.	Ref. to Agreement dated	:
xiv.	EarnestMoneyDeposit	:

MANDATORY TESTS

- 1. The mandatory tests shall be carried out when the quantity of materialsto incorporate in the work exceeds the minimum quantityspecified.
- 2. Optional tests specified or any other tests, shall be carried out in case of

specialized works or important structures as per direction of the Engineer-in-

Charge.

- 3. Testing charges, including incidental charges and cost of sample for testing shall be borne by the contractor for all mandatorytests.
- 4. Testing charges for optional tests shall be reimbursed by the Department. However, the incidental charges and cost of sample for testing shall be borne by thecontractor.
- 5. In case of non-IS materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant IS specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractor for suchtests.

Material	Test	Field / laborat ory test	Test procedure	Minimum quantity of material / Work for carrying out the test	Frequency of testing
Reinforced	cement concrete	work			
Water fo r constructi on purposes	Ph value Limits of Acidity Limits of Alkality Percentage of solidsChlorid es Suspended matter Sulphates Inorganic Solids Organic solids	Lab	IS 3025	Water from each source	Before commencement of work & thereafter: Mandatory - Once in one yea from each r source; Optional: once in 3 months from each source; Municipal supply - optional.
Reinforce d cement concrete	b) slump test	Field	IS: 1199	a) 20 cum. fo slabs, bea r ms and connecte d	a) 20 cum. Part there of or morefrequently Asrequired by

THE MANDATORY TESTS SHALL BE AS FOLLOWS:

				columns.	theEIC/Consul
				b) 5 Cum	tant
				in case ofcolumns	b) Every 5Cu.m.
	c) cube test	Lab	IS: 516	a) 20 cum. In	a) every 20 cum of a
				slab, beams,	concreting
				connected	.(Ref. as per
				columns.	frequency of
				b) 5 cum in	sampling).
Danaki	Cube test	lab	15-516 and a	50 cum	b) Every 5 cum.
Ready	CODE lesi	LOD	IS-STO UNU U S	50 COIT	One for every 50cum of
mixed			per para 6.3.2		production or
cement			of IS-4926-2003		every 50
Concrete					batches, whichever is the greater
(IS-4926)					frequency
Note: for c carried out	all other small iter as required by El	ms and where C/Consultant	RCC done in a	a day is less that	n 5 cum, test may be
				Minimum	
Material	Test	Fiel d	Test procedure	quantity of material / Work	Frequency of testing
		/ laboratory		for carrying	
		/ laboratory test		for carrying out the	
		laboratory test		for carrying out the test	
Mortars:	Chemical &	laboratory test	IS; 6932 (part 1	for carrying out the test 5 M.T.	10 M.T. or part there
Mortars: Lime	Chemical & physical	, laboratory test Laboratory	1S; 6932 (part 1 to x)	for carrying out the test 5 M.T.	10 M.T. or part there of as decided by the
Mortars: Lime	Chemical & physical properties of lime	laboratory test	1S; 6932 (part 1 to x)	for carrying out the test 5 M.T.	10 M.T. or part there of as decided by the EIC/Consultant
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	Field	IS; 6932 (part 1 to x)	for carrying out the test 5 M.T. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	, laboratory test Laboratory Field	1S; 6932 (part 1 to x)	for carrying out the test 5 M.T. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more,
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	Field	15; 6932 (part 1 to x)	for carrying out the test 5 M.T. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	, laboratory test Laboratory Field	1S; 6932 (part 1 to x)	for carrying out the test 5 M.T. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	Field	IS; 6932 (part 1 to x)	for carrying out the test 5 M.T. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more as
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand	Field	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field Field or	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M. 40 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant Every 40 cu. of fine
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field Field or	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M. 40 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant Every 40 cu. of fine m. aggregate (
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field Field or Laboratory	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M. 40 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant Every 40 cu. of fine m. aggregate / sand required in RCC.
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field or Laboratory test	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M. 40 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant Every 40 cu. of fine m. aggregate / sand required in RCC. Work
Mortars: Lime Sand	Chemical & physical properties of lime Bulking of Sand Silt content	Field Field or Laboratory as decided by the	IS; 6932 (part 1 to x) IS:383	for carrying out the test 5 M.T. 20 CU.M. 20 CU.M. 40 CU.M.	10 M.T. or part there of as decided by the EIC/Consultant Every 20 cu.mor part thereof or more, frequently as decided by EIC/ Consultant Every 20 cu.mor part thereof or more, as frequently as decided by the EIC/ Consultant Every 40 cu. of fine m. aggregate / sand required in RCC. Work only

	Organic Impurities	Field	DO	20 CU.M.	Every 20 cum. or part thereof or more frequently as decidedby the EIC/Consultant
	Chloride & sulphate content tests		Optional		Once in three months.
Cement	Test requirement	Fineness (m2/kg)	IS 4031 (Part-II)	Each fresh lot	Every 50 MT or part thereof
		Normal consistency	IS 4031 (Part-IV)		
		Settingti me (minute) a) Initial b) Final	IS 4031 (Part-V)		
		Soundne ss a) Le- Chat expansion (mm) b) Auto clave (%)	IS 4031 III) (Part-		
		Compressive strength (Mp) a) 72+/-1 hr b)168+/-2hr	IS 4031 (Part- VI)		
Material	Test	Field / laborato ry test	Test procedur e	Minimum quantity of material / Work for carrying out the test	Frequency of testing
Stone Aggregat e	a) Percentage of soft or deleterious materials	General visual inspection/ Lab test where required by the EIC/Consulta nt	IS 2386 Part II	One test for eachsou rce	One test for each source

	Particle size distribution	Field / Lab	-	10 cum	Every 40 cum. Or part thereof and	
	Once in three months for each source for coarse and fine aggregates required in RCC works, for a minimum quantity - 10 cum for coarse aggregate and 40 cum for fine aggregate.					
	a) Estimation of Organicimpurit ies	Field / Lab	IS 2386 Part II	10 Cum	-do-	
	b) Specific Gravity	Field / Lab	IS 2386	10 Cum	-do-	
	a) Bulk Density	Field / Lab	IS 2386	10 Cum	-do-	
	b)Aggregate crushingstre ngth	Field / Lab	IS 2386	10 Cum	-do-	
	c) Aggregate impact value	Field / Lab	IS 2386	10 Cum	-do-	
Bricks	Testing of bricks /brick tilesfor dimensions Compressive strength Water absorption Efflorescence	Laboratory	IS 3495 Part I to IV	No of bricks to be selected & bricks lot 20: 2001 to 10000 32: 10001 to35000. 50:35001 to50000 20: for every addl. 50000 or part thereof If <2000, As per decision of the EIC/Consultant	Permissible defective bricks in the sample 1 2 3	
Material	Test	Field /	Test procedure	Minimum quantity of material /	Frequency of testing	
		laborato ry test		Work for carrying out the test		
	Physical tests	Lab / field			Below 100 Tons	
Steel FOR RCC	a)Tensile strength		IS 1608	Each Iot from each source from each	Dia < 10 mm one sample for each 25 tonesor part thereof	
			IS 1786	diameter of ba	If dia is >10 mm but	

b) Retest c) Re-bound test d) Nominal mass e) Bendtest f) Elongationtest	IS 1786 IS 1786 IS 1599 IS 1786 IS 1786		less than 16 mm: One sample each 35 tonesor partthereof. If dia>16 mm one samplefor each 45tons
g) Prootstress Chemical Tests: 1.CarbonConsti tuent 2. Sulphur 3.Phosphorus 4. Phosphorus Sulphur	IS 1786		For every fresh lot of one Truckor less as directed by the Engineer-in Charge/Consultant
Soil core testOMC Proctor density	A p IS 12175 s er	Tw fo every o r 50 sq m	As per notes 1 & 2below

TESTING, TOLERANCE, ACCEPTANCE AND MODE OF PAYMENT:

a) The material should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant IS for acceptance. Such materials shall be accepted asstandard.

b) Payment shall be restricted to standard unit mass, or as specified in the schedule of work, without making any cost adjustment towards mass or anyother properties, provided the material pass all the tests and tolerances are within thespecified limits.

c)In case of non-standard materials, materials not covered under any IS Specifications, suchas aluminium sections, the payment shall be made based on the actual unit weight basis as determined by testing at randomsampling.

Notes:

1. BACK FILLING IN SIDES OF FOUNDATIONS, PLINTH, UNDER FLOORETC.:

The back filling shall be done after theconcrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was Constituenttemporarily deposited and shall be used in backfilling. The scope of work for back filling/filling in foundation, plinth, under floors etc. shall include filling for all the buildings covered under the contract. Surplus earth available from one building, if required, shall be used for backfilling/filling for other buildings alsowithin the specified lead mentioned in theitem. All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be back filled to the original surface with approved materials in layers not exceeding 150 mm. in thickness, watered and well consolidated by means of rammers to at least 90% of the consolidation obtainable atoptimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areasinaccessible to mechanical equipments uch as a reas a diacent to walls and column setc .shallbetampedby hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 75 mm.in any direction, salt, clods, organic or other foreign materials which might rot. The backfilling in plinth and under floors shall be done in similar way in layers not exceeding 150 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will becarried out by the Contractor cost. Two tests per 50 sqm. will be taken to ascertain theproper consolidation.

2. FILLING IN PLINTH AND UNDER FLOORS:

After the available suitable excavated materials are exhausted as backfilling, the contractor shallnotify the Engineer-in-Charge, of the fact and levels taken jointly with Site Engineer / Consultant/Authority of CIPET Authority. The earth, murum, sand, gravel etc.or such materials suitable for filling proposed to be filled under floors and so mentioned in the item of schedule of quantities shall then be brought to site from approved locations and sources.

i) **Earth Filling:**The earth, soft murum etc. so brought shall be filled up in layers of 15 cm depth, each layer being well watered and consolidated by approved hand or mechanical tampers or other suitable means to achieve the required density.

ii) Gravel or Sand Filling: Gravel if required to be filled under floors, shall be single washedgravel of approved quality and of size varying from 12 mm. to 20 mm.it shall be uniformly blinded with approved type of soil and/or sand to obtain full compaction. Gravel shall be filled in specified thickness and shall be well watered and rammed entirely to the satisfaction of the Site Engineer / Consultant.

If sand is required to be filled under floors, it shall be clean, medium grained and free from impurities. The filled in sand shall be kept flooded with water for 24 hrs.to ensure maximum consolidation. Any temporary work required to maintain sand under flooded condition shall be done by the contractor at his own cost. The surface shall then be well dressed got approved from SiteEngineer / Consultant before any other work is taken over the fill.

Signature of the Contractor:

Address:

Date:

Chief Manager(Project) MGM CONSTRUCTION DEPARTMENT MGM CAMPUS, N-6, CIDCO, CHH. SAMBHAJINAGAR