

# **TECHNICAL SPECIFICATIONS FOR CIVIL WORKS**

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## **TECHNICAL SPECIFICATIONS - CIVIL – MATERIALS**

### **1.0 WATER**

1.1 Water used shall be clean and free from organic impurities etc. Potable water is generally considered satisfactory for construction and during purpose. Water for construction purpose shall be tested for suitability as per IS codes at the start of the project and also at every **three** months interval.

### **2.0 CEMENT**

2.1.0 Cement used shall be any of following types with prior approval of Engineer in Charge: -

- a) Ordinary or Low Heat Portland Cement conforming to IS: 269-1976.
- b) Rapid Hardening Portland cement conforming to IS: 8041-1978.
- c) Portland Blast Furnace Slag Cement conforming to IS: 455-1976.
- d) Portland Pozzolana cement conforming to IS: 1489-1976.
- e) White Portland cement conforming to IS: 8042-19789.
- f) Ordinary Portland cement conforming to IS: 8112 (43-Grade)

NOTE: -

- i) Low Heat Portland cement conforming to IS: 269-1976 shall be used with adequate precautions with regard to removal of formwork etc.,
- ii) White Portland cement is generally used for architectural and decorative purpose and is generally meant for non structural use.
- iii) Generally ordinary Portland cement is used for construction purposes.

### **2.2.0 ORDINARY PORTLAND CEMENT**

Shall conform to the requirements of IS 8112 (43 Grade).

#### **2.2.1 Physical Requirements**

- i) Fineness; - Specific surface shall not be less than 2250cm<sup>2</sup>/grn.
- ii) Soundness: - Expansion (unaerated) shall be not more than 10 mm by Le Chatelier method. If it fails, expansion of aerated sample shall not be more than 5mm. Expansion by Autoclave test shall not be more than 0.8%.
- iii) Setting Time :-
  - a) Initial: not less than 30 minutes.
  - b) Final: Not more than 10 hours.
- iv) Compressive Strength of mortal cubes (1 cement :3 standard sand) shall not be less than following:
  - 330 kgf/cm<sup>2</sup> at 168+/-2 hours
  - 430 kgf/cm<sup>2</sup> at 672+/-4 hours

### **2.3.0 PORTLAND POZZOLANA CEMENT**

shall conform to the requirements of IS 1489-1976

#### **2.3.1 Physical Requirements :-**

- i) Fineness :- Specific surface shall not be less than 3000 Sq. cm/gm.

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ii) Soundness :- Expansion (unaerated) shall be not more than 10mm by Le Chatelier method. If it fails, expansion of aerated sample shall not be more than 5mm. Expansion by Autoclave test shall not be more than 0.8%

iii) Setting Time :-

a) Initial: not less than 30 minutes

b) Final: not more than 10 hours

iv) Compressive Strength of mortar cubes (1 cement: 3 standard sand) shall not be less than following:

--- 220 kgf/cm<sup>2</sup> at 168+/-2 hours

--- 310 kgf/cm<sup>2</sup> at 672+/-4 hours.

v) Drying shrinkage :- not more than 0.15%

#### 2.4.0 TESTING

The details of test for cement shall be as given in IS: 4031-1968 (Methods of physical tests for hydraulic cement) and IS: 4032-1968 (Method of chemical analysis of hydraulic cement).

#### 3.0 AGGREGATES:

3.1.0 Aggregates shall consist of naturally occurring stones, gravel and sand and shall be hard, strong dense durable clear and free from veins, adherent coating and injurious amounts of disintegrated pieces and deleterious substances.

3.1.1 Aggregates shall not contain harmful organic impurities such as pyrites, laminated material, alkali, seashells and organic impurities and those, which may attack the reinforcement when used in RCC work. Aggregates shall not be chemically reactive with alkalis of cement.

#### 3.2.0 FINE AGGREGATES:

3.2.1 Aggregates most of which passes 4.75mm size IS sieve is known as fine aggregates. The sum of the percentage of all deleterious materials shall not exceed 5%.

3.2.2 Fine- aggregates shall be either sand or crushed stone dust. However, generally sand is used as fine aggregate for concrete or mortar. Two varieties of sand are available normally:

i) **FINE SAND:** This shall be natural river sand conforming to the requirements of IS:383-1970. Its grading shall be within the limits of grading zone IV of the table shown below:

#### IS SIEVE

#### PERCENTAGE PASSING FOR

DESIGNATION	-----			
	GRADING ZONE I	GRADING ZONE II	GRADING ZONE III	GRADING ZONE IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

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Note-Fine aggregate conforming to grading Zone IV shall not be used in reinforced concrete unless ascertained for suitability by mix designing.

**ii) COARSE SAND:-**This shall be either river sand or pit sand conforming to the requirements of IS:383-1970. It shall be clean, sharp, angular, strong and composed of hard silicious material. Its grading shall be within the limits of zone I, II or III of the table shown above.

3.2.3 The maximum quantity of silt content shall not exceed 8%.

#### **3.2.4 TESTING:-**

The details of test shall be as per IS:2386 (part I) -1963 to IS:2386 (part VIII)-1963 (Methods of testing aggregates for concrete).

#### **3.3.0 COARSE AGGREGATES:-**

3.3.1 Coarse aggregates used for concrete can be either stone, gravel (river bed shingle or pit gravel) or brick. However, crushed stone shall be used as coarse aggregates for concretes.

#### **3.3.2 STONE:-**

This shall be crushed or broken from hard stone obtained from approved quarry. It shall be hard, strong, dense, durable, clean and free from soft, thin, flat, elongated or laminated, flaky pieces and shall be roughly cubical in shape. It shall be clean and free from dirt and any foreign matter. However the total amount of deleterious materials shall not exceed 5% of its weight.

3.3.2.1 SIZE :- Graded aggregate of nominal sizes 40, 20, 16 or 12.5 mm shall conform to the requirement of the table given below:

IS SIEVE	PERCENTAGE PASSING FOR NOMINAL SIZE OF			
	40 MM	20MM	16MM	12.5MM
80.0	100	-----	-----	-----
40.0	95-100	100	-----	-----
20.0	30-70	95-100	100	100
16.0	-----	-----	90-100	-----
12.5	-----	-----	-----	90-100
10.0	10-35	25-55	30-70	40-85
4.75	0-35	0-10	0-10	0-10
2.36	-----	-----	-----	-----

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3.3.2.2 Single size aggregate (ungraded) of nominal sizes 63, 40, 20, 16, 12.5 or 10 mm shall conform to the requirements of the table given below:-

IS SIEVE DESIGNATION	PERCENTAGE PASSING FOR NOMINAL SIZE OF					
	63 MM	40 MM	20 MM	15 MM	12.5 MM	10 MM
80	100	-----	-----	-----	-----	-----
63	85-100	100	-----	-----	-----	-----
40	0-30	85-100	100	-----	-----	-----
20	0-5	0-20	85-100	100	-----	-----
16	-----	-----	-----	85-100	100	-----
12.5	-----	-----	-----	-----	85-100	-----
10.5	-----	0-5	0-20	0-30	0-45	85-100
4.75	-----	-----	0-5	0-5	0-10	0-20
2.36	-----	-----	-----	-----	-----	0-5

### 3.3.3 TESTING:

The details of test shall be as per IS : 2386 (part-I)-1963 to IS 2386 (part VIII)-1963 (Methods of testing aggregates for concrete).

## 4.0 BRICKS:-

4.1.0 Common burnt clay building bricks having compressive strength upto 400 kg/cm<sup>2</sup> shall conform to IS:1077-1976.

4.1.1 Burnt clay bricks having compressive strength more than 400 kg/cm<sup>2</sup> shall conform to IS:2180-1978

4.1.2 Bricks shall be hand or machine molded and free from cracks and flaws and nodules of free lime. Bricks of 9 cm height shall be provided with frog of 1 to 2 cm deep on one of its flat sides. No frog is required for 4 cm height bricks and extruded bricks.

### 4.2.0 CLASSIFICATION :-

4.2.1 Bricks shall be classified based on their compressive strength as given in table below:

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CLASS DESIGNATION	AVERAGE COMPRESSIVE STRENGTH NOT LESS THAN KG/SQ. CM.
350	350
300	300
250	250
200	200
175	175
150	150
125	125
100	100
75	75
50	50
35	35

4.2.1.1 Each class of brick shall be further divided into sub classes A and B based on tolerances and shape.

4.2.1.2 Sub class A bricks shall be smooth rectangular faces with sharp corners and uniform colour.

4.2.1.3 Sub class B bricks may have slightly distorted and rounded edges.

4.2.1.4 The bricks of class designation 100 shall have smooth rectangular faces with sharp corners and emit clear ringing sound when struck. Tolerances on dimensions upto +/-3% shall be permitted. Dimension test to be carried out as per IS.

4.2.1.5 Bricks of class designation 75, 50 and 35 may be permitted to have slight distorted and rounded edges provided no difficulty shall arise on this account in laying of uniform courses. Tolerances on dimensions upto +/- 8% shall be permitted. Dimension test to be carried out as per IS.

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#### **4.3.0 PHYSICAL REQUIREMENTS:**

4.3.1 Compressive Strength: This shall conform to table given above. Compressive strength of any individual brick shall not fall below this minimum requirement by more than 20%.

4.3.2 Water Absorption :- Shall not be more than 20% upto class 125 and not more than 15% for higher classes.

4.3.3 Efflorescence :- The rating of efflorescence shall not be more than moderate upto class 125 and not more than slight for higher classes.

#### **4.4.0 TESTING:-**

The details of test shall be as per IS-3495-1976 Part I, II and III (Method of test of burnt clay building brick).

Part I: Determination of Compressive Strength

Part II : Determination of water absorption

Part III : Determination of efflorescence

Percentage of Deleterious materials (testing).

#### **5.0 STEEL REINFORCEMENT:-**

5.1.0 The steel reinforcement as specified shall be as follows:-

a) Mild steel and medium tensile bars - IS 432 Part 1-1982.

b) Cold twisted HYSD bars IS 1786-1979.

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**MILD STEEL AND MEDIUM TENSILE STEEL:-**

5.1.1.1 The physical requirements for mild steel, Grade I and II and medium tensile bars shall be as per table below:

PROPERTY	NOMINAL SIZE OF BARS	MILD STEEL		MEDIUM TENSILE STEEL
		GR.I	GR.II	
i) ULTIMATE TENSILE STRESS, KG/SQ. MM MINIMUM	ALL SIZES	42	38	55
ii) YIELD STRESS, KG/SQ. MM MINIMUM.	UPTO & INCL. > 20 MM >	26	23.5	36
	UPTO AND ) INCL. 40 MM )	24	21.5	34.5
	OVER 40 MM	24	21.5	33
iii) ELONGATION, PERCENT MINIMUM	UNDER 10 MM	20	20	17
	10 MM & OVER	23	23	20

**NOTE:** - Mild steel Grade II is available in two varieties designated as ST 42-0 and ST 32-0. ST 42-0 only shall be used conforming to above requirements. ST 32-0 shall not be used as reinforcement.

**5.1.1.2 Note:** Grade II mild steel bars shall not be used in the following conditions:

- i) Where structures are located in earthquake zones subjected to severe damage.
- ii) Where the structures are subjected to dynamic loading (other than wind loadings such as railway and highway bridges).
- iii) Where welding has to be employed for fabrication
- iv) Where the design of structures are based on plastic theory.

**5.1.1.3 WEIGHT:**

The tolerance on weight for round and square bars shall be the following percentage of the weight calculated based on unit weight of 0.785 kg/cm<sup>2</sup>/m run.

- Upto and including 8mm - + 4%
- Over 8mm - + 2.5%

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#### **5.1.1.4 TESTING**

The details of test shall be as follows:

- i) Tensile test: As per IS 226-1962 and IS 1608-1972.
- ii) Bend test: As per IS 1599-1960.

#### **5.1.2 COLD TWISTED BARS:**

5.1.2.1 The physical requirements of all sizes of cold twisted bars whether plain or deformed shall be as follows:

--- Tensile strength :- Minimum 49.5 kgf/sq. mm

--- 0.2% proof stress :- Minimum 42.5kgf/sq.mm

--- Elongation:- Minimum on gauge length 5.65/60 where so is the cross sectional area of the test piece - 14.5%

#### **5.1.2.2. WEIGHT:**

The tolerance on the weight of the bars shall be the following percentages of the weight calculated on the above:

- Upto and including 8 mm - + 4%
- Above 8mm - + 2.5%

#### **5.1.2.3 TESTING:**

The details of test shall be as per IS 226-1962, IS 1608-1972 and IS 1599-1974 for selection and preparation of test samples, tensile test and bend test.

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**STRUCTURAL STEEL:****SCOPE OF WORK:**

The work covered by this specification consists of supplying, fabricating and erecting of structural steel members for columns, beams, trusses, ladders, grills, doors etc., made out of RS joists, plates, angles, bars, flats, box sections etc., complete in strict accordance with the specifications and the applicable drawings.

**MATERIALS:**

All structural steel shall be of standard sections as marked on the drawings and shall be free from scale, blisters, laminations, cracked edges and defects of any sort.

All structural steel and electrodes shall comply in all respects with I. S. for structural steel.

**WORKMANSHIP:**

All workmanship shall be of first class quality in every respect to the greatest accuracy being observed to ensure that all parts will fit together properly on erection.

All ends shall be cut true to planes. They must fit the abutting surfaces closely.

All stiffeners shall be fit tightly at both ends.

All butt ends of compression members shall be in close contact through the area of the joints.

The base connection shall be provided as shown on drawings and the greatest accuracy of workmanship shall be ensured to provide the best connections.

Figured dimensions on the drawings shall be taken.

**ERECTION AND MARKING:**

Erection and fabrication shall be according to I. S. 800-1984 section-II. During erection, the work shall be securely braced and fastened temporarily to provide safety for all erection stresses etc. No permanent welding shall be done until proper alignment has been obtained.

Any parts which do not fit accurately or which are not in accordance with the drawings and specifications shall be liable to rejection and if rejected, shall at once be made good.

Engineer-in-Charge shall have full liberty at all reasonable times to enter the contractor's premises for the purpose of inspecting the work and no work shall be taken down, painted or dispatched until it has been inspected and approved.

The contractor shall supply free of charge all labour and tools required for testing of work.

**DELIVERY AT SITE:**

Contractor shall deliver the component parts of the steel work in an undamaged state at the site of the works and the Engineer-in-Charge shall be entitled to refuse acceptance of any portion which has been bent or otherwise damaged before actual delivery on work.

**PAINTING:**

Painting shall be strictly according to I. S. 1477-1971 (Part-I-Pre-treatment) and I. S. 1477-1971 (Part II-painting).

Painting shall be carried out on dry surfaces free from dust, scale etc. The paint shall be approved by the Engineer-in-Charge.

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Two coats of Synthetic Enamel paint of approved colour and make over two coats of red oxide primer shall be applied on steel, except where it is to be encased in concrete or where surfaces are to be field welded.

**WELDING:**

Welding shall be in accordance with I. S. 816-1969, I. S. 819-1957, I. S. 1261-1959, I. S. 1323-2982 and I. S. 9595-1989 as appropriate

**WELDING CONSUMABLE:**

Covered electrodes shall conform I. S. 814 (Part-II) - part II) 1974 or I. S. 1395-1972.

Fill rods and wires for gas welding shall conform to I. S. 1278-1972.

The bare wire electrodes for submerged arc welding shall conform to I. S. 7280-1974. The combination of arc and flush shall satisfy the requirements of I. S. 3613-1974 .

The filler rods and bare electrodes for gas shielded metal arc welding shall conform to I. S. 6419-1971 and I. S. 6560-1972 as appropriate.

**TYPES OF WELDING:**

Shielded metal arc welding (Direct or alternating current) or Oxyacetylene welding may be used. Field welding may be used. Field welding shall be by D. C.

**WELDING PROCEDURE:**

Welding should be done with the structural steel in flat position in a down hand manner wherever possible. Adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work. Welding plant capacity shall be adequate to carry out the welding procedure laid down. Adequate means of measurement of the current shall be available either as a part of the welding plant or by the provision of a portable ammeter. In checking welding current, a tolerance of 10% or 30 amperes from the specified value, whichever is less, shall be permitted.

The welding procedure shall be such as to ensure that the weld metal can be fully and satisfactorily deposited through the length and thickness of all joints so that distortion and shrinkage stresses are reduced to the minimum and thickness of welds meet the requirements of quantity specified.

**WORKMANSHIP:**

**PREPARATION OF FUSION FACES:**

Fusion faces shall be cut by shearing machine or gas cutting and later dressed by filing or grinding so that they shall be free from irregularities such as would interfere with the deposition of the specified size of weld to cause the defects. Fusion faces and the surrounding surfaces shall be free from heavy slag, oil paint or any substance which might affect the quantity of the weld or impede the progress of welding. The welding face shall be free of rust and shall have metal shine surfaces.

The parts to be welded shall be brought into as close contact as possible and the gap due to faulty workmanship or incorrect fit up shall not exceed 1/16". If separation of 1/16" or more occurs locally, the size of the fillet weld shall be increased at such position by an amount equal to the width of the gap.

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The parts to be welded shall be maintained to their correct position during welding. They shall be securely held in position by means of tack welds, service bolts, clamps or rings before commencing welding so as to prevent relative movement due to distortion, wind or any other cause.

All welds shall be deposited in a pre-arranged order and sequence taking due account of the effects of distortion and shrinkage stresses.

After making each run of welding, all slag shall be removed and shall be protected by clean boiled lined oil till approved.

The weld metal, as deposited shall be free from crack, slag, excessive porosity, cavities and other faults.

The weld metal shall be properly fused with the parent metal without overlapping or serious undercutting at the toes of the weld.

The surface of the weld shall have a uniform and consistent contour and regular appearance.

In welds containing crack, porosity or cavities in which the weld metal tends to overlap on the parent metal without proper fusion, the defective portions of the welds shall be cut out and re-welded. Where serious under cutting occurs, additional weld metal shall be deposited to make good reduction.

#### **MODE OF MEASUREMENT:**

All structural steel shall be measured on weight basis in metric tones or quintals or kgs as mentioned in the schedule of quantities. The length or areas of various members including gusset plates shall be measured correct to two places of decimals and the net weight worked out from the standard steel tables published by Bureau of Indian Standards.

No separate measurements shall be taken for welding, riveting, bolting, field connections Etc. The rate shall include cost of all labour, materials, scaffolding, transport and also cost of welding, riveting and bolting, field connections if any all to complete the job as per specifications.

#### **PLUMBING WORK**

##### **GI PIPES & SOCKETS**

#### **MATERIALS:**

The pipes shall be galvanized mild steel welded and seamless, screwed and socketed tubes conforming to the requirement of IS-1239 /1982 for specified grade. They shall be of diameter (nominal bore) as specified in the description of item.

The pipes and sockets shall be clean finished, well galvanized in and out, free from cracks, surface flaws, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut clean and square with the axis of the tube. Unless otherwise specified, the pipes below GI or concealed in walls or floors shall be C class and those supported on walls shall be of B class .

All screwed tubes and sockets shall have pipe thread conforming to the requirements of IS: 544-1975. Tubes shall be screwed with taper threads while the sockets with parallel threads.

#### **PIPE FITTING:**

The fittings shall be of seamless wrought steel or mild steel tubulars complying with the requirements given above or as specified. The fittings shall be designated by the respective nominal bores of the pipes, for which they are intended.

The fittings shall have screw threads at the ends shall be parallel for female threads and taper threads for male.

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### **CUTTING, LAYING AND JOINTING**

The pipes and fittings shall be inspected at site before use to ascertain that they conform to the specifications given above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filed out so that no obstruction to the bore is offered. The ends of the pipes shall then be threaded with pipe dies and taps carefully in such a manner as will not result in slackness in the joints when two pieces are screwed together.

The taps and dies shall be used only for straightening the screw thread which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of the pipes and fittings shall be protected from damage until they are fitted.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of Teflon tape or spun yam wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, Tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly joined so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burrs from the joints shall be removed after screwing. After laying, the open ends of the pipe shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

At Y threads exposed after jointing shall be painted or in the case of under ground piping thickly coated with approved anti corrosive paint to prevent corrosion. The pipes shall be laid in chases or exposed to suit the conditions or as specified. All pipes laid in chases shall be coated with hessian cloth impregnated with bitumen and pipe exposed shall be painted with two coats of synthetic enamel.

### **TESTING OF JOINTS:**

After laying and jointing, the pipes and fittings inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without any extra cost. The following procedure shall be followed for testing of pipes. NO work shall be covered until it has been tested and found OK by EIC.

The pipes and fittings after they are laid shall be tested at hydraulic pressure of 2 kg/sqcm. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off points shall be plugged and stopcocks shall be closed and specific hydraulic pressure shall be applied gradually. The test pump shall be stopped, the test pressure shall be maintained without loss in pressure for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, keeping the joints exposed for inspection during testing.

### **MEASUREMENTS:**

The length shall be measured in running meter correct to a centimeter. For the finished work, which shall include GI pipe and GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples, unions and nuts but excludes brass or gun metal taps, valves etc.

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## **TECHNICAL SPECIFICATIONS - CIVIL WORKMANSHIP**

### **EARTHWORK**

#### **GENERAL, DEFINITIONS**

##### **DEADMEN OR TELL TALES:**

Mounds of earth left undisturbed in pits dug out for borrowing earth.

##### **FORMATION:**

Final shape or profile of the ground after excavation or filling up.

##### **PROFILE:**

The pattern to which the earth is to be out or made up and dressed.

##### **FILL:**

Shall mean earth, sand, stabilized aggregate or other material specified to replace earth or rock removed during construction.

##### **CLASSIFICATION**

The earth shall be classified, measured and paid separately for categories as mentioned below:

##### **ORDINARY SOIL**

Any soil which can be removed with the ordinary or close application of bicks or jumpers or scarifiers and rippers.

##### **ORDINARY ROCK**

Which may be quarried by crowbars or picks such as limestone, sandstone, hard laterite, hard conglomerate, and unreinforced concrete below ground level shall be treated as ordinary rock.

##### **PROTECTION**

- a) Trenches and foundation pits shall be securely fenced and proper caution sign and night lighting shall be arranged.
- b) Any excavation shall not be carried out below the foundation level of adjoining structure unless proper precautions like underpinnig shoring etc are taken.

### **EXACAVATION FOR FOUNDATION**

#### **SCOPE**

Excavation for normal spread footings, trenches, u/g storage tanks, excavation over large areas, etc.

#### **SITE CLEARENCE**

Before the earth work is started the area shall be cleared of shrubs, vegetation, grass brush, wood, trees and rubbish.

The roots of trees shall be removed to a minimum 600mm below ground level or 30 cm below formation level whichever is lower and the hollows shall be filled up with earth, leveled and rammed.

#### **SETTING OUT AND MAKING PROFILES**

Masonry pillars will be erected at suitable points to serve as benchmark, for execution of work. These bench marks shall be connected to standard bench mark if required by Engg.-in-charge / Architects. In addition to these pillars, centre line pillars shall also be erected by the contractor and footing positions shall be marked with the help of these pillars.

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The necessary profile shall be set out. The level shall be taken at an interval as directed by Engg.-in-charge / Architects but the intervals shall not be more than 5 meters in any case. The levels shall be recorded in field books and plotted on plan before starting the excavation and the same shall be countersigned by the Engg.-in-charge / Architects.

**CUTTING FOR FOUNDATION:**

The cutting shall be done to minimum depths as indicated in the drawings and if required the depth shall be increased to obtain proper strata for foundations. Any excess excavation carried out by the contractor without the proper authorization from etc shall not be paid and the excess depth shall be made good by the contractor by PCC 1:4:8.

**CUTTING TRENCHES:** Unless otherwise indicated on the drawings, trench excavation shall be by open out and the bottom of the trenches for piping shall be accurately graded so that the pipe is uniformly supported along its entire length. After trench bottom has been graded all holes or depressions for other type of piping joints shall be cut below the trench to the depth necessary for the particular joint.

**BACKFILLING:**

Backfilling of the excavated spaces shall be done with the selected material from the excavation. Backfilling shall be done to the original ground level or the elevation shown on the plan in layers of 150mms to 220mms and well compacted. When the excavated earth is not suitable or adequate for backfill then approved backfill material shall be brought from outside and the same shall be paid separately. Backfilling is to be done in such a manner as not to cause undue thrust on the any part of the structure.

**TRENCH BACKFILL:**

Backfilling of trenches for pipelines shall be done first over the middle portion of each length of pipe bringing the cover to a depth of at least 300mm over the top of the pipe while leaving all field joints exposed. After all required tests on the piping have been carried out and approved by the Engg.-in-charge / Architects the remaining trench backfill shall be accomplished. Extreme care shall be exercised during backfilling operations to prevent damages to coated or wrapped pipes.

**SIDE PROTECTION FOR DEEP EXCAVATION:**

In case of excavation for foundations exceeding 2.0 meters depth from existing ground level, proper precautions shall be taken to prevent sides from collapse. This can be ensured by adopting anyone of the following methods given below and as directed by EIC.

1. Stepping
2. Side slopes
3. Planking and Strutting

The first two methods can be adopted where the soil is not loose and sloping/stepping is possible. The sides slopes shall be done to such a degree that the sides are stable. In case of very loose and trecherous soil, planking and strutting shall be done to avoid collapse. Planking and strutting shall be done in accordance with IS 3764 (Safety code for excavation works). Sheetings, shorings and bracings shall be maintained in place until immediately before filling or backfilling and then shall be removed by stages as the filling or the backfilling progresses. The responsibility of designing, supplying and erecting a sound and stable shoring system rests with the contractor and shall be approved by EIC before execution.

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**DEWATERING:**

In case of water being encountered during the excavation for foundation, the contractor shall arrange for adequate capacity of dewatering system. Pumping shall be controlled to dispose of water to drainage ditches and shall not be routed to cause inconvenience to the construction operation in general.

**MEASUREMENT:**

The length, breadth and depth shall be measured to nearest centimeter and the quantity shall be worked out in cubic meters to two decimal places. The depth shall be taken as per drawing or as excavated under special conditions under instructions from Engineer-in-Charge/Architects. The width and length shall be taken as per length and width of PCC as per drawing.

**MORTARS:****CEMENT MORTAR:****SCOPE**

This shall cover cement mortars used in general building works for masonry work and plastering.

**Materials:**

Cement, Water and Waterproofing compound: As specified in Materials specifications.

**Sand:**

sand as specified in clause 3.2.0 of materials section shall be used.

**Proportioning:**

Proportion of sand and cement shall be as specified. The unit of measurement for cement shall be a bag of cement weighing 50kgs and this shall be taken as 0.035 cum. Sand in specified proportion shall be measured in boxes of suitable sizes. It shall be measured on the basis of its dry volume. If the sand is wet, the quantities shall be increased suitably to allow for bulkage.

If the sand as specified for plastering is not available, proper sieving shall be carried out at site to obtain the required fineness modulus and only such sieved sand shall be used for plastering work.

**Mixing:**

The mixing of mortars shall be done in mechanical mixers operated manually or by power. The Engg.-in-Charge / Architects may however relax this condition taking into account the nature and the location of the work.

**Mixing in Mechanical Mixers:**

Cement and sand in specified proportion shall be mixed dry thoroughly in a mixer and then water shall be added gradually and wet mixing shall continue for at least one minute. Water shall be added only in such proportion to bring the mortar to the consistency of a stiff paste. Only the quantity of mortar which can be used within 30 minutes of its mixing shall be prepared at a time. The mixer shall be cleaned with water each time before suspending the work.

**Hand Mixing:**

The measured quantity of sand shall be leveled on clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by turning over backwards and forwards several times till the dry

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mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed in masonry troughs with just sufficient quantity of water to bring the mortar to the consistency of a stiff paste.

## **CONCRETE WORKS :**

### **MATERIALS:**

Water, cement, lime, surkhi, coarse aggregates, fine aggregate shall be as specified in above Section.

### **Cement Concrete:**

#### **Scope:**

This shall cover plain cement concrete in leveling courses, subgrades, coping, kerbs, steps, sills etc.

#### **Proportion:**

Shall be done by volume, Boxes of suitable sizes shall be used for measuring sand and aggregates. The unit measurement of cement shall be a bag of 50 kgs and this shall be taken as 0.035 cum.

While measuring the aggregates, shaking, heaping, ramming shall not be done.

The proportioning of sand shall be on the basis of its dry weight and in case of damp sand allowances for bulkage shall be made. Different sizes of boxes are advised to be used while measuring sand with bulkage allowance.

Mixing shall be done in mechanical mixers. Mixing by hand shall not be permitted unless specific prior permission of the Engg.-in-Charge/ Architects has been obtained in writing.

#### **Machine Mixing:**

The mixture drum shall be cleaned with water and half the required quantity of dry coarse aggregates shall be placed first in the hopper followed by cement and sand and finally the balance quantity of coarse aggregates shall be put in the hopper. The dry material shall be mixed for at least four turns of the drum after which the correct quantity of water shall be added gradually while the drum is in motion. The materials shall be mixed for not less than a period of two minutes and until a uniform colour and consistency is obtained.

#### **Hand Mixing:**

Shall be done on smooth clean watertight platform. Measured quantity of sand shall be spread and the required number of bags of cement shall be distributed evenly on top of sand. The sand and cement shall be mixed intimately by turning the mixture over and over again to get a uniform colour. The sand cement mixture shall be spread and measured quantity of coarse aggregates shall be distributed on top of it. This shall be mixed at least three times by shoveling. A hollow shall be made in the middle of the mixed pile and three quarter of total quantity of water shall be poured into it while the material is turned in towards the centre with spades. The remaining water shall be added slowly turning the whole mixture over and again until a uniform colour and consistency is obtained.

### **CONSISTENCY:**

The quantity of water to be used for each mix of 50 kg cement to obtain the required consistency shall not be more than 34 liters for 1:3:6 mix, 30 liters for 1:2:4 mix, 27 litres for 1:1:5:3 mix.

In case of vibrated concrete, the limits specified shall be suitably reduced to avoid segregation. The quantity of water shall be regulated by carrying out regular slump cone tests as specified. The following slumps shall be adopted for different kind of works :

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Description	Slump in mm	
	With Vibrators	Without Vibrators
<b>Plain Cement Concrete :</b>		
Mass concrete in foundation, Footings, retaining, walls And pavements :	10 - 25	50 - 75
Thin sections of flooring less than 75mm thk	25 - 40	75 - 100
<b>Reinforced concrete :</b>		
Mass concrete in RCC Foundations, footings Retaining walls	10 - 25	80
Beams, slabs and columns Simply reinforced	25 - 40	100 - 125
Thin RCC sections or Sections with congested steel	40 - 50	125 - 150

#### **LAYING:**

The concrete shall be laid gently in layers not exceeding 150mm. Mechanical vibrators shall be used for compaction.

Hand compaction may be permitted by Engg.-in-charge / Architects depending upon the thickness of the member and feasibility of vibrating the same. Hand compaction shall be done with the help of tamping rods. Next layer of concrete shall be carried out before initial setting starts in the previous layer i.e. within 30 minutes.

Concreting shall not be carried out if the temperature falls below 4°C. During hot weather care shall be taken to see that the temperature of concrete does not exceed 38°C. When the concreting is suspended, necessary removal of laitance and roughening of surface for jointing shall be done before concrete sets. On the resumption of work the joint shall be thoroughly cleaned, roughened, watered and a grout of neat cement slurry (1Kg of cement in 2Lt of water) shall be applied uniformly.

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**CURING:**

Green work shall be protected from rain by suitable covering. After about 1 to 2 hours of concreting, the surface of concrete shall be protected from drying with the help of moist gunny bag, sand or any other approved method. After 24 hours the surface shall be flooded with water of min. 25mm depth. The curing shall continue for minimum 14 days or more if required by Engg.-in-Charge / Architects. The masonry work can be started after 48 hours of concreting, but the curing shall continue for minimum 14 days along with masonry.

**FORM WORK :**

Shall be as specified in R.C.C. section.

**REINFORCED CEMENT CONCRETE:****SCOPE:**

This shall cover general reinforced cement concrete work in footings, columns, beams, piers, slabs, overhead /underground tanks, retaining walls, etc.

**SETTING OUT WORKS:**

All the center lines and reference lines shall be permanently marked on brick masonry pillars and these pillars along with the center line marking shall be preserved till the completion of work. Reference bench marks wherever required shall also be built and maintained.

**MATERIALS:**

All materials like cement, sand, aggregates and steel shall conform to the specifications details in the Materials section.

**CEMENT:**

Cement supplied in bags (gunny, multi paper or cloth) shall be stored and stacked in dry and waterproof sheds. Bags shall be stacked at least 10 to 20 cms clear above the floor. A space of 60 cms all round shall be left between the exterior walls and the stacks. Cement bags should be placed close together to reduce circulation of air as much as possible. Bags shall be stored one above the other in stacks not more than 10 bags to avoid lumping under pressure. If more than 7 bags are stacked one above the other the same should be arranged in header and stretcher fashion to avoid toppling. For extra safety during monsoon or when cement is to be stored for longer periods, the entire stack shall be enclosed in polythene sheets or any other suitable water proofing material. When removing the cement bags for use, first in first out principle should be adhered to. Each consignment of cement when received at site, shall be stacked separately to permit easy access for inspection and facilitate removal.

Aggregates required for concrete work shall be stored separately as their sizes and grades. All aggregates shall be stored on a clean hard surface, preferably on a floor of bricks.

**FORMWORK**

Unless specified the formwork shall be of plywood not less than 10mm thick or steel plates not less than 3mm thick with suitable frames. Plain surfaces shall be adequately strengthened at edges and centre bracing to prevent buckling, warping or bending. Faces in contact shall be free from adherings, grouts, projecting nails, splits and other defects.

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**FIXING AND ERECTING FORMWORK:****PROPS:**

Props used for shuttering shall be of steel, timber posts, and ballis. In no case ballis used shall be of diameter less than 100mm at mid length and 80 mm at thin end. Maximum permissible spacing in case of ballis shall be 1.2 meters centre to centre.

In case of structures with two or more floors, the weight of concrete shuttering and centering of any upper floor being cast shall be suitably supported on one floor below the topmost floor already cast. Formwork and concreting of upper floors shall not be done until concrete of the lower floor has set for at least 14 days. For all cantilever beams and slabs, the props shall not be removed for 28 days.

The above specification is applicable only for spans upto 4.5 meters and heights upto 3.5 meters. In case any of the limits are exceeded the formwork shall be properly designed.

**BRACINGS:**

Upto 3.0 meter height, single stage bracing shall be provided and from 3.0 - 4.5 meter height double stage bracing shall be provided.

**SHUTTERING:**

All the joints in shuttering shall be leak proof. Faulty joints shall be caulked to prevent leakage. Connections shall be constructed to permit easy removal of the shuttering and shall be either nailed, screwed, bolted, clamped or wired.

The connections should be strong enough to retain the correct shape during consolidation of concrete. The chamfers beveled edges and molding shall be made in the formwork itself. Opening for the fan clamps and other fittings for services shall be provided in the shuttering as directed. Care shall be taken while providing dowel bars so that the holes in the shuttering are leak proof. Shuttering shall be true to line and level and braced to prevent deformation under the weight and pressure of wet concrete, constructional load, wind and other pressures. The shuttering of beams and slabs shall be so erected that the shuttering on the sides of the beams and of the soffit of the slabs can be removed without disturbing the beam bottoms.

**SURFACE TREATMENT FOR SHUTTERING:**

Any approved mould oil or other material shall be used. For timber shuttering the surfaces coming in contact with concrete shall be well wetted and coated with soap solution, raw linseed oil or form oil of approved manufacturer.

**CAMBER**

Suitable camber shall be provided in horizontal members especially in long spans to compensate the effects of deflection. The camber for beams and slabs shall be 4 mm per meter and the camber for cantilever at the free end shall be 1/50 of the projected length.

**REMOVAL OF FORMWORK:**

The formwork shall be removed in such a way that no damage is done to the concrete work due to shock or vibration. In case of horizontal members, formwork should be eased carefully in order to prevent the load being suddenly transferred to the concrete. The minimum required period before de-shuttering is given in the table below: -

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Part of Structure For removal of formwork	Minimum period
Sides of foundations, columns, Beams and walls	48 hours
Undersides of slabs upto 4.5 m span	7 days
Undersides of slabs above 4.5 m span And undersides of beams upto 6.0m span	14 days
Undersides of beams over 6.0 m and Upto 9.0 m span	21 days
Undersides of beams over 9.0 m span	28 days

**Note:**

In case of cantilever slabs and beams, the centering shall remain till structures for counteracting or bearing –down have been erected and have attained adequate strength.

Proper precautions shall be taken to allow for the decrease in the rate of hardening with all cements in cold weather.

**MEASUREMENT:**

Wherever specified as a separate item, the formwork shall be paid for separately. The concrete items mentioned in the tender are inclusive of shuttering and formwork.

**REINFORCEMENT:**

All the reinforcement used in RCC work shall conform to the specifications as described in Materials section.

**GENERAL:**

All reinforcement shall be clean and free from loose mill scales, dust, coats of paint, oil, loose rust or other coatings which may destroy or reduce bond.

**BENDING AND OVERLAPPING:**

All reinforcement bars shall be made perfectly straight before bending. Bars shall be bent by suitable machine or manually round by a pin having a diameter not less than four times the diameter of the bar being bent, producing a gradual and even motion. Bars shall be bent cold. No reinforcement shall be bent when in position on the works.

Bending shall comply with the dimensions given in the approved bending schedule (tolerances permitted is 0.5%) In case of mild steel, the ends of rods shall be bent into a semicircular hook having clear diameter equal to four times the

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diameter of the bar with a length beyond the bend equal to four times the diameter of the bar. In case of deformed bars, the hooks are not required.

Overlapping of the bars where necessary, shall be done as directed by the Engg.-in-charge / Architects. The overlapping bars shall be bound together at interval not exceeding ten times the diameter of the smaller diameter bar with two strands of annealed steel wires of 18 SWG thickness twisted tight. The overlap shall be staggered for different bars and located at points, along the span, where neither shear nor bending movement is maximum. Where facility is available welding of bars shall be restored to in view of overlap.

#### **PLACING IN POSITION:**

Reinforcement bars shall be placed in position as shown in the drawings. The bars crossing one another shall be tied together at every intersection with two strands of binding wire. Tack welding shall also be permitted in lieu of binding with steel wire.

The bars shall be kept in position by the following methods: -

- a) In case of beam and slab construction, precast cover blocks (cement mortar 1:2 blocks, pieces of broken mosaic tiles or plastic cover blocks) of thickness equal to the specified cover shall be placed between the bars and shuttering.
- b) In case of cantilever and double reinforced beams or slabs, the vertical distance between horizontal bars shall be maintained by introducing chair spacers of steel at 1 meter or less spacing to avoid sagging.
- c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them or with cover blocks suitably tied to the reinforcement.

#### **MEASUREMENT:**

Reinforcement including authorised spacer bars and laps shall be measured in lengths of different diameters as actually used in the work nearest to a centimeter and their weight calculated on the basis of standard tables. Wastages and unauthorized overlaps shall not be paid. Annealed steel wire required for binding shall not be measured. Wherever welding is restored in lieu of laps such welds shall be measured separately in numbers for different size of reinforcement.

#### **CONCRETING**

The concrete shall be as specified under "Cement Concrete". Concrete shall be mixed by mechanical mixer only and no hand mixing shall be allowed for RCC works.

#### **CONSISTENCY:**

The consistency of the concrete shall be such that it flows sluggishly into the forms and around the reinforcement without any segregation of coarse aggregate from mortar. The consistency shall depend on the mode of compaction viz., vibrated or hand tamped. The slump tests are mandatory and shall be carried out at regular intervals so that the consistency of concrete can be monitored.

For details see under cement concrete.

#### **PLACING OF CONCRETE:**

Concreting shall commence only after inspection and approval by Engg.-in-Charge / Architects of shuttering, centering and reinforcement are placed. The approval for concreting shall be given in writing by Engg.-in-charge / Architects.

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Shuttering shall be clean and free from shavings, saw dust, pieces of wood or other foreign material and proper de-shuttering agent shall be applied to the surface.

Proper arrangements shall be provided for conveying the concrete to the place of deposition without disturbing the reinforcement. This can be achieved by providing wooden planks or catwalks supported directly on centering by means of wooden blocks or lugs. The labour shall not be allowed to walk on the reinforcement.

In case of columns and walls it is desirable to place concrete without construction joints. To achieve this a concrete pouring window should be provided in one of the sides of formwork approximately 2 to 3 feet from bottom to facilitate placement of concrete and compaction of the bottom portion and avoid segregation of the concrete. Rate of concreting in vertical direction shall be restricted to one meter per hour.

The concrete deposited in its final position shall be in a cohesive mass and no segregation shall be allowed. In deep trenches and footings, concreting shall be placed through chutes as directed by Engg.-in-Charge / Architects.

### **COMPACTION**

Concrete shall be compacted into a dense mass immediately after placing by means of mechanical vibrators. Use of mechanical vibrators for compaction may be relaxed depending on the thickness of the members and feasibility of vibrating the same. Hand compaction shall be done with the help of tamping rods. The different layers of concrete shall be placed before the final setting of the previous layer takes place.

Concrete shall be judged being properly compacted when the mortar fills the spaces between the coarse aggregates and begins to cream up to form an even surface. If vibrating table and the external vibrators are being used, they shall be stopped as soon as the compaction is over. In case of needle vibrators the needle shall be withdrawn slowly to prevent formation of loose pockets. Shaking of the reinforcement for purpose of compaction shall not be allowed. Compaction shall be completed within thirty minutes from the time of addition of water to the dry mixture.

### **CONSTRUCTION JOINTS**

Before starting the concrete, the position and location of the construction joint shall be decided, if not indicated on the drawings, and proper arrangements like stop board with necessary slots for reinforcement bars shall be made. No construction joint shall be located in valleys. Preferably the joint shall be kept at places where the shear force is minimum and the joint shall be straight and at right angles to the direction of the main reinforcement. In case of columns, the joint shall be horizontal and 10 to 15 cm below the bottom of the beam. Any concrete flowing through the joints of stop board shall be removed soon after the initial set.

When the work has to be resumed, the joints shall be thoroughly cleaned with wire brush and loose particles removed. A coat of neat cement slurry at the rate of 2.75 kg of cement per square meter shall be applied before fresh concrete is laid.

### **CURING:**

Shall be as specified in "Cement Concrete".

### **FINISHING:**

In case of roof slabs, the top surface shall be finished even and smooth before the concrete begins to set.

In case of RCC slabs which are to be treated with any flooring shall be roughened with wire brushes while the concrete is green.

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**STRENGTH OF CONCRETE:**

The compressive strength on work tests for different mixes shall be as follows:

Concrete Mix	Compressive strength Kg/cm <sup>2</sup>	
	7 days	28 days
1:1:2	210	315
1:1.5:3	175	265
1:2:4	140	210

**INSPECTION AND RECTIFICATION OF DEFECTS:**

Immediately on removal of forms, the RCC works shall be examined by the Engg. -in-Charge / Architects before any defects are made good.

The work that has sagged or contains honey combing to an extent detrimental to the structural safety or architectural concept shall be rejected.

Surface defects on a minor nature may be accepted and the same shall be rectified as follows:

- a) Bulges due to movement of forms, ridges at forms, ridges at form joints shall be carefully chipped and then rubbed with a grinding stone.
- b) Honeycombed and other defective areas must be chipped out, the edges being out as straight as possible and perpendicular to the surface. Shallow patches are first treated with a coat of thin grout (1 cement: 1 sand) and then filled with mortar similar to that used in concrete. Large and deep patches shall be filled up with concrete held in place by forms and shall be reinforced.
- c) Holes left by bolts shall be filled carefully with mortar. Holes extending right through the concrete shall be filled with mortar with a pressure gun.
- d) The same amount of care to cure the material in patches should be taken as with the whole structure.

**POST TREATMENT OF SURFACE:**

The surface which has to receive plaster or where it has to be joined with brick masonry walls shall be properly roughened immediately after the shuttering is removed.

**ACCEPTANCE CRITERIA OF CONCRETE WORK:**

Minimum of six sample cubes shall be taken for all concreting work (periodicity as specified in 9.6 of section III) and three cubes shall be tested after 7 days curing and balance after 28 days curing.

**7 Days Test:**

The average strength of the three specimens shall be accepted as the compressive strength of the concrete provided that the difference between maximum and minimum strength of the three cubes does not exceed 15% of average strength.

In case the 7 days strength is not satisfactory all further work structurally interlinked with the concrete represented by the samples shall be stopped till the remaining three cubes are tested for 28 days strength and are found satisfactory.

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**28 Days Test:**

The tests should generally be carried out on 28th day, but in no case, should be delayed beyond 35 days. The strength of the cubes shall be as specified in table above if they are tested on the 28th day. In case, the cubes are tested after 28 days, the minimum acceptable compressive strength shall be increased by 1.5 kg/cm<sup>2</sup> for each day beyond 28th day.

The acceptance criteria of 28 days test shall be as follows;

- a) If the average compressive strength of three cubes is more or equal to the compo Strength shown in table above, the concrete shall be accepted at full rates.
- b) If the average compo Strength of the three cubes is less than specified but not less than 75% of the specified strength, the concrete shall be accepted at reduced rates at the discretion of EIC. The reduced rate shall be calculated on proportionate basis, i.e. for every percent decrease in the specified strength the rate shall be reduced by the same, percentage.
- c) If the average compressive strength of the three cubes is less than 75% of the specified strength, eic shall either reject the defective portion or get it dismantled along with the structurally connected work as considered necessary at the risk and cost of the contractor. Eic may also desire to carry out additional tests on the defective work and if on the basis of these additional tests, eic is satisfied about the structural adequacy of the concrete the concrete work may be accepted at the reduced rate as specified in b) above except, for the reduced strength below 75% for which the reduction shall be 1.5 times for every percent decrease below 75%

Example: Average compressive strength is 70% of specified strength. The rate payable shall be  $75 - 1.5 (75-70) = 67.5\%$  of tendered rate.

**MEASUREMENT**

All measurements shall be as per IS 1200

**KOTA STONE FLOORING:****MATERIAL**

Kota stone slab shall be of selected quality, hard, sound, dense and homogenous in texture free from cracks, decay, weathering and flaws. The exposed surface of the slab shall be machine polished to a smooth even and true plane and the edges machine cut square and to the required shape where necessary. The thickness of the slab shall be 20, 30 or 40 mm as specified. Tolerance of +2 mm shall be allowed in thickness and +/- 5mm shall be allowed in respect of length and breadth. The sample of the slab shall be approved by engineer in charge before commencing work. Other materials like lime, cement, sand shall conform to specifications detailed in Materials section Lime used for flooring shall be of class 8 type.

**PREPARATION OF SURFACE AND LAYING:**

Subgrade concrete or RCC slab on which kota stone flooring is to be laid shall be cleaned, wetted and mopped. The bedding for the slab shall be in cement mortar 1:4 or with lime and sand mortar 1:2 or as specified. The average thickness of the bedding mortar below the slab shall be 20 mm and thickness at any place under the slab shall not be less than 12mm.

Mortar of the specified mix shall be spread under the area of each slab roughly to the average thickness specified in the item. The slab shall be washed clean before laying. Neat cement grout of honey like consistency shall be spread over

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the mortar bed as much area as can be covered with the slabs within half an hour. The stone slab shall be laid on the neat cement floor and shall be evenly and firmly bedded to the required level and slope. Each slab shall be gently tapped with a wooden mallet so as ensure proper bedding. The thickness of joint shall not exceed 1.5 mm and shall be of uniform thickness and in straight lines. Joints shall be grouted solid with neat cement slurry for the full depth. Surplus cement slurry on the surface of the slab shall be cleaned off. Slabs which are fixed in the floor adjacent to wall shall enter not less than 12mm under the plaster, skirting or dado.

**CURING AND POLISHING:**

The flooring shall be well wetted with sand or water for seven days. After the bedding and the joints have completely set the surface shall be machine polished to mirror finish.

**KOTA STONE IN RISERS, SKIRTING OR DADO:**

**MATERIALS:**

As specified above.

**LAYING, CURING AND POLISHING:**

Kota stones shall be laid against a bedding of cement mortar 1:4 20mm average thickness to the full height of the skirting to a true plane level and plumb. The projection of the skirting shall be 6mm beyond the plaster surface. The skirting surface shall be re-polished by hand to the satisfaction of the Engg.-in-charge / Architects. Curing shall be done for a minimum period of seven days.

**MEASUREMENTS:**

Measurement shall be done for the actual length of skirting and deduction shall be made for the areas not covered by skirting in running meters.

**MASONRY:**

**BRICKWORK:**

**SCOPE:** Shall cover brick masonry works of 225 thick or more in all buildings, walls, etc.

**CLASSIFICATION:** Brick work shall be classified according to the class designation of bricks used.

**MORTAR:** The mortar shall be as specified, Materials, preparation and mixing of mortar shall be as specified in "MORTAR" section.

**SOAKING OF BRICKS:** Bricks required for masonry in cement! lime mortar shall be thoroughly soaked in clean water for at least one hour in tanks of tanks of sufficient size immediately before use. The soaked bricks shall be kept on wooden planks or brick platform to avoid earth smearing on them.

**LAYING:** 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. Closure in such cases shall be cut to the required size and used near the end of the wall.

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A layer of mortar shall be spread on full width over a suitable length of lower course. Each brick shall be properly bedded and set home in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. On completion of a course, all vertical joints shall be fully filled from the top with mortar.

The wall shall be taken, truly plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate course shall come directly one over the other. The thickness of the brick courses shall be kept uniform and for this purpose, wooden edge with graduations giving thickness of each brick course including shall be used. The height of window sill, bottom of lintels and such other important points shall be marked on it. A set of tools comprising of a wooden straight edge, mason spirit level, square, two foot rule, line and pins, strings and plumb shall be kept on the side of the work.

Both the faces of walls of thickness greater than 225 mm shall be kept in proper plane. The connecting brick work shall be carried out nearly at one level and no portion of work shall be left more than one meter below the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not exceeding 45 degrees.

All iron fixtures, pipes outlets of water, holdfasts of doors, 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 position as the work proceeds.

The work done per day should not be more than one meter in height.

#### **JOINTS:**

Bricks shall so be laid that all joints are full of mortar. The thickness of joints shall not exceed one cm for brickwork of any class designation. All face joints shall be raked to a minimum depth of 10 mm by a raking tool during the progress of work where 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 brickwork shall be cleaned on the same day on which brickwork is laid and all mortar dropping shall be removed promptly.

#### **CURING:**

Brickwork shall be protected from rain by suitable covering when mortar is green. Masonry work in cement mortar and lime mortar shall be kept constantly moist on all faces for a minimum period of seven days. Brickwork carried out during the day shall be suitably marked indicating the date on which the work is done to keep a control on the curing period.

#### **SCAFFOLDING:**

For all exposed brickwork or tile work, double scaffolding having two sets of vertical supports shall be provided. For all other brickwork single scaffolding shall be permitted. Where single scaffolding is provided, the horizontal scaffolding pole shall rest in a hole provided only in the header course. No holes for scaffolding shall be provided in pillars, columns and immediately near the skewback of arches.

#### **MEASUREMENT:**

Unless otherwise specified, all brick masonry works shall be measured correct to a centimeter and the area shall be calculated in square meters to the nearest two decimal places.

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**STONEMASONRY:****SCOPE:**

Shall include all stonemasonry work in general and erection of stonewalls.

**MATERIALS:**

Cement, sand shall conform to the specifications detailed in Materials section. Mortars of specified mix shall conform to "Cement Mortars".

**RANDOM RUBBLE MASONRY:**

Stone : Stones used for this purpose shall be hard, sound, free from decay, weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials, etc. Stone shall be sharp, angular and round stones shall not be used.

Generally, blue basalt or granite shall be used for masonry works.

The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than  $\frac{3}{4}$ <sup>th</sup> of the thickness of wall. The height of stone may be upto 30 cm.

Stones shall be hammer dressed on the face, sides and the beds to enable it to come into close proximity with adjacent stones. The bushing in the face shall not project more than 20 mm. For exposed masonry and 10 mm for masonry which is to be plastered.

**LAYING:**

Stones shall be wetted before use. The wall shall be carried up truly plumb. Every stone shall be fitted carefully with the adjacent stones to form neat and close joints. The bond shall be obtained by using bond stones. Face stones shall extend well into the backing and these shall be arranged to break joints as much as possible and avoid long vertical lines of joints. The interior filling of the wall shall consist of rubble stones of any shape but shall not pass through a circular ring of 15 cm dia. Thickness of these inner stones shall not be less than 10 cm. The inner stones shall be carefully laid hammered down with a wooden mallet into position and solidly bedded into mortar. Use of chips and spalls shall be limited and should be used only to avoid thick mortar joints.

**Bond Stones:** Bond stones or through stones running right through the thickness of walls shall be provided in walls upto 60 cm thick and in case of walls more than 60 cm thick, a set of two or more bond stones overlapping each other by 15 cm shall be provided in a line from face to back. At least one bond stone shall be provided for every 1.0 sqm. of wall surface.

**Joints:** Stones shall be so laid that all joints are full of mortar. Face joints shall not be more than 25mm thick. When plastering and pointing is not required to be done, the joints shall be struck flush or raised pointed as per requirement and finished at the time of laying.

**SCAFFOLDING, CURING AND MEASUREMENT:**

Shall be as per Brick Masonry.

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**PLASTERING:****SCOPE:**

This covers cement plaster finishes to column, ceilings, walls and similar surfaces on backgrounds met with such as brick, stone or concrete.

**MATERIALS:**

All materials like sand and cement shall conform to specifications detailed in 'materials section'.

**MORTAR:**

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in "Cement Mortars", For external and undercoat work, the fine aggregate conforming to Grading IV and for finishing coat work the fine aggregate conforming to Grading V shall be used.

**SCAFFOLDING:**

Scaffolding shall be done in line with details specified under "BRICK WORK".

**PREPARATION OF SURFACE**

Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scraping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if chemical retarder has been applied to the formwork, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

**APPLICATION:**

Ceiling plaster shall be first completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster of about 15 x 15 cm shall be first applied horizontally and vertically, at 3 meters intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform manner slightly more than the specified thickness and brought to true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according to whether a smooth or a sandy granular texture is required. Excessive trowelling or overworking the float shall be avoided.

All comers, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering comers, arrises, junctions, etc, where required shall be done without any extra payment. Such rounding or chamfering shall be carried out with proper templates to the sizes required. Plastering and finishing shall be completed within half an hour of adding water to the dry mortar. In suspending work at the end of the day the plaster shall be left out clean to line both horizontally and vertically and while recommencing the edge of the old work shall be scraped, cleaned and wetted to enable proper jointing.

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**Notes:**

Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm to any comers or arrises.

Horizontal joints in plaster shall not occur on parapet tops and copings as these invariably lead to leakages.

No portion of the surface shall be left out initially to patch up later on.

**CURING:**

Curing shall be commenced as soon as the plaster has hardened sufficiently. Plaster shall be kept wet for a period of seven days.

**20mm THICK CEMENT PLASTER (TWO COAT WORK) :****MORTAR:**

This shall be done at detailed under cement mortars. Generally coarse sand shall be used for the undercoat (first coat) and fine sand for the finishing coat (second coat) unless otherwise specified.

**APPLICATION**

The plaster shall be applied in two coats, i.e. 12mm thick under coat and 8 mm. Thick finishing coat and shall have an average total thickness of not less than 20mm.

12mm thick undercoat:

This shall be applied as detailed above. However, when the plaster has been brought to true surface with a wooden straight edge, the surface shall be left rough and 2mm deep furrows shall be made with a scratching tool to form key for the finishing coat. The surface shall be kept wet till the finishing coat is applied.

8mm thick finishing coat:

The finishing coat shall be applied as detailed above after the undercoat has sufficiently set but not dried and in any case within 48 hours of laying the undercoat. The surface shall be finished with special rubbing by sponge pads and other tools recommended for cement plaster work to obtain a uniform textured surface.

Curing shall be as detailed above.

**CEILING CEMENT PLASTER:****SCAFFOLDING:**

Shall. be as detailed under "Brick Masonry" and stage scaffolding shall be provided independent of the walls.

PREPARATION OF SURFACE: Projecting burrs of mortar formed due to gaps at joints in shuttering shall be removed, the 'Surface shall be scrubbed with wire brushes. Concrete surfaces shall be hacked at spacing not more than 5cm centers and depth shall not be less than 3mm. Surface shall be well wetted before applying the plaster.

**MORTAR**

Mortar of specified mix shall be used and shall conform to the specifications detailed under "Cement Mortars".

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**APPLICATION:**

Ceiling plaster shall not be commenced until the slab above has been finished and centering has been removed. In the case of ceilings of roof slabs, plaster shall not commence until the terrace work has been completed. This is to ensure that ceiling plaster is not disturbed by the vibrations set or in the above operations. To ensure even thickness and true surface, gauges of plaster 15 x 15 cm shall be first applied at not more than 1.5 meter centers in both directions true in the plane of finished surface.

The plaster shall be then applied in a uniform manner to a thickness little more than the specified thickness and shall be then brought to true and even surface by working with a wooden straight edge reaching across the gauges. Finally the surface shall be finished true with a trowel to obtain a smooth surface. The work shall be checked frequently with a true straight edge not less than 2.5 meter long.

**THICKNESS**

The average thickness of plaster shall not be less than 6mm. The minimum thickness over a portion of the surface shall not be less than 4mm.

**POINTING:**

SCOPE: This shall include cement mortar pointing on brickwork and stone work.

**MATERIALS:**

Cement and sand for plastering shall conform to specifications detailed in Materials section.

**SCAFFOLDING:**

For exposed brickwork or stonework, scaffolding having two sets of vertical supports shall be provided.

**MORTAR:**

Shall be of specified mix and as specified in Cement Mortars.

**PREPARATION OF SURFACE:**

The joints shall be raked out properly while the mortar is green. Efflorescence if any, shall be removed by brushing and scraping. The surface shall be washed with water and kept wet before pointing is commenced. The joints shall be raked in such a fashion that the minimum depth of new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick/stone shall not be less than 12mm.

**APPLICATION AND FINISHING:**

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing required. Care shall be taken that mortar does not spread over the corner, edges and surface of the masonry. The pointing lines shall be truly horizontal and vertical except where the joints are slanting as in RR masonry. Lines of joints from different directions shall meet neatly at the junctions. The pointing shall be finished with proper tool as follows:

1. Flush Pointing: The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of bricks/stones. The edges shall be neatly trimmed with a trowel and a straight edge.

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2. Raised Pointing: Raised pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band with about 6mm projection and 10mm width.

3. Sunk Pointing: The mortar shall be pressed into joints and the top of the horizontal joint shall then be neatly pressed back about 3mm or as directed with the pointing tool.

**CURING:**

The pointing shall be kept wet for about 7 days and during this period it shall be protected from all damages.

**MEASUREMENTS:**

Length and breadth shall be measured correct to a cm and area shall be calculated in square meters up to two decimal places. The measurement of plaster shall be taken before the plastering is done. No deductions shall be made or extra paid for openings less than 0.5 sqm. Openings more than 0.5 sqm shall be deducted but additional measurements shall than 0.5 sqm shall be deducted but additional measurements shall be taken for jambs, sills and soffits. Skirting of the wall shall not be measured (if the skirting is of different finish)

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## TESTING OF BUILDING MATERIALS

The contractor shall carryout the following tests at his own expense and as directed by the Engg.-in-charge / Architects.  
Engg.-in-charge / Architects reserves their right to ask the contractor to carry out any further tests on any material which is being used in the project.

**WATER:** Suitability for construction/ concreting purposes as per IS 456-2000

**Periodicity:** One test at the beginning of the project and once in every change of source

### SANDS

Tests to be conducted

- a. Particle size - Lab
- b. Silt content - Field
- c. Bulking of sand-Field
- d. Percentage of Deleterious material / Organic impurities -lab

Is code for material- IS-383-1970

IS code for testing - IS-2386 (Part I) to IS-2386 (Part VIII)

Periodicity of testing

Whenever there is a change in source of supply or as directed by the Engineer-in-Charge.

Remarks

1. Silt content should not exceed 8%.
2. For sand pad foundation no need of particle size distribution. Only silt & bulk content to be carried out.

### Sand (for plastering)

Tests to be conducted

- a) Particle size - Lab
- b) Silt content - Field
- c) Percentage of Deleterious/ organic impurities - Lab.

IS code for material- IS-1542

IS code for testing - IS-I727

### Periodicity of testing

Same as above, Test shall be repeated for Minimum qty. 500 sq. m of plastering.

Remarks

1. Silt content not to exceed 5%
2. Sand to be sieved in sieve size 4.75 mm

### COARSE AGGREGATE

Tests to be conducted

- a. Percentage of Soft deleterious materials- Field (Visual)
- b. Particle size distribution
- c. Aggregate value;
  - I. Crushing - Lab
  2. Impact - Lab

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3. Abrasion - Lab (Only for Roads)

IS code for material - IS-383-1970

IS code for testing - IS-2386 (Part I) to IS 2386 (Part VIII)

**Periodicity of Testing**

Minimum 45 cum. Tests to be repeated for every 45 cum of coarse aggregate or part thereof.

Remarks

Percentage of soft deleterious materials. Usually visual inspection shall be carried out. If Engg.-in-Charge / Architects has doubts, the same may be tested in Lab.

**CEMENT**

Tests to be conducted

a. fineness - Lab

b. Soundness - Lab

c. Setting Time - Lab

d. Compressive strength - Lab

Periodicity of Testing

Minimum qty. 20 MT, Tests to be repeated for every 100 MT or part thereof or change of supplier.

Remarks

Cement to be tested if supplied by the contractor. Cement to be tested if stored for more than 3 months.

**CEMENT CONCRETE**

Tests to be conducted

a. Slump test - Field

b. Cube strength - Lab/field

**Periodicity of Testing**

a. Once for minimum 5 cum.

b. Minimum 15 cum of part thereof.

Remarks

Cube strength to be taken for both 7 days as well as 28 days. Cubes of critical members (decided by Engg.-in-Charge) shall be tested at lab.

**REINFORCEMENT STEEL**

Tests to be conducted

a. Free from defects - Field (Visual)

Weight - Lab

Size - Lab

Ultimate tensile stress - Lab

Yield stress - Lab

Elongation percentage - Lab

Bend Re-bend test - Lab

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IS code for material

- IS-432 for mild steel
- IS-1786 for Tor steel

IS code for testing - IS-1608

**Periodicity of Testing**

Minimum qty: 10 MT, tests shall be repeated for every 10 MT of each size (dia) or part thereof.

**Remarks**

- a. Steel shall be tested if supplied by contractor.
- b. Steel shall be tested if stored in open yard for more than one year.

**BRICKS**

Tests to be conducted

- a. Compressive Test - Lab
- b. Water absorption - Lab
- c. Efflorescence - Lab'
- d. Percentage of Deleterious material- Lab.
- e. Dimension test-Lab

IS code for material - IS-1 077 -1986

IS code for Testing - IS-3495 (Part I) to IS-3495 (Part III)

**Periodicity of Testing**

Minimum 20000 bricks but tests shall be repeated for every 40000 or part thereof depending on the volume of work.

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**THEORITICAL CONSUMPTION OF CEMENT IN VARIOUS ITEMS OF WORK**

<b>ITEM / WORK</b>	<b>UNIT</b>	<b>CONSUMPTION / UNIT IN 50 KG BAGS</b>
<b>MORTARS</b>		
1:3	CUM	10.2
1:4	CUM	7.6
1:5	CUM	6.2
1:6	CUM	5.0
<b>CONCRETE</b>		
1:1:2	CUM	12.2
1:1.5:3	CUM	8.0
1:2:4	CUM	6.4
1:3:6	CUM	4.4
1:4:8	CUM	3.4
<b>BRICK MASONARY</b>		
1:4	CUM	1.8
1:5	CUM	1.56
1:6	CUM	1.24
<b>HALF BRICK MASONARY</b>		
1:3	SQM	0.29
1:4	SQM	0.21
<b>STONE MASONARY</b>		
1:6	CUM	1.7
<b>PLASTERING - 12 MM THICK</b>		
1:6	SQM	0.072
1:5	SQM	0.084
1:4	SQM	0.102
<b>PLASTERING - 20 MM THICK</b>		
1:3	SQM	0.23
1:4	SQM	0.17

For all other works, which are not covered in the above list, the actual cement consumed during the execution shall be recorded i.e., for water proofing works, etc.

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**LIST OF APPROVED BRAND / MANUFACTURERS**

<b>Sl. No.</b>	<b>MATERIAL</b>	<b>BRAND / MANUFACTURER</b>
1	Cement	ACC, Birla, L & T, Gujarat Siddhi, Gujarat Ambuja, Rajashri.
2	Reinforcement steel	SAIL, TISCO, RIN
3	Water proofing compound	CICO, IMPERMO, ACCOPROOF, ROFFE, CHEMISOL
4	Plastic emulsion	ICI Dulux, Berger, Asian, J & N, Goodlass nerolac
5	Synthetic enamel paint	Berger, Asain, J&N, Goodlass nerolac.
6	Cement Paint	Snowcem, Nitcocem, Terracem.
7	Ceramic tiles	Kajaria, Johnson, Somani, Bell, Naveen.
8	Hardware for doors/ windows	CIEF or Approved equivalent
9	Aluminium sections	Jindal, INDAL. HINDALCO
10	Glazing	Modi float, Asahi float
11	Kitchen sink	Nirali, AMC,
12	Sanitary ware	Parry, Hindustan, Neycer,
13	CP fittings	Jaquar or equivalent
14	GI pipes	Tata, Jindal, Zenith or approved equivalent
15	GI Fittings	R Brand Kirti or approved equivalent
16	CI pipes and fittings	NECO
17	Gate valves	Leader , Sant
18	Watermeter	Capstan or approved equivalent
19	Flush doors	Anchor, Kitply, Alpro
20	CI covers	NECO
21	RCC hume pipe	Indian Hume Pipe or approved equivalent
22	PVC pipes	Finolex, Supreme, Garware

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