B. SPECIFICATION FOR CIVIL WORKS

B1. STANDARD CONSTRUCTION MATERIALS

1. WATER

Water for construction work shall not be salty or blackish and shall be clean drinking water, reasonably clear and free from objectionable quantities of silt and traces of oils, acid and injurious alkali, salts, organic matter and other deleterious material which will weaken the concrete. Water shall be obtained from the sources approved by the Engineer. Sources of water shall be maintained at such a depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass or other foreign materials. Containers for transport, storage and handling of water shall be clean.

2. CEMENT

Cement shall conform to I.S. 269-1976 / I.S. 8112-1989. The type of the cement as to whether it shall be ordinary Rapid Hardening or Low Heat shall be specified. When no type is specified, Ordinary Portland Cement shall be used.

The weight of Ordinary Portland Cement shall be taken as 1440 kg per cum and Rapid Hardening Portland Cement as 1210 kg per cum. The measurement of proportion of cement should normally be on the basis of weight and whole bags each undisturbed and sealed 50 kg. When part bag is required, cement shall be taken to see that each bag contain full quantity of cement.

Tests: when tests are considered necessary, they shall be carried out as indicated in I.S. 269-1958/I.S. 8112-1989. The contractor should ensure that the cement is of sound and required quality before using it.

Storage: cement required for use shall be as fresh as possible and stored on planks raised 15 to 20 cms above the storey and stacked 30 cms away from the walls in suitable closed weatherproof buildings at the work site or at the selected approved site in such a manner as to prevent deterioration by dampness or moist atmosphere or intrusion of foreign matter. Cement shall be stored in such a way as to allow the removal and use of cement in chronological order of receipt, i.e. first received being first used. Not more than 15 bags shall be stacked vertically in one pile and maximum width of the piles should not be more than 3 meters. Any cement which has deteriorated cracked or which has been damaged shall not be used. Cement concerning which there is doubt shall not be used pending testing and satisfactory results. Cement that is condemned shall be immediately removed from the work site. When temporarily stored in the open for use within 48 hours, it shall be kept on a platform of planks about 15 to 20 cm above ground and covered with a tarpaulin. Ordinary cement stored for more than 2 months from the date of receipt from the factory shall be subjected to test and used only if found satisfactory. The cost of test shall be borne by the Agency responsible for the storage after two months from receipt. Different kinds or brands of cement or cement of the same brand from different factory (mills) shall be stored in separate groups and shall not be mixed during use except when directed in writing by the Engineer. Cement shall be kept in a store under double locking arrangement so that it can be taken out or fresh stock admitted with the knowledge of supervising staff of the Works. A board indicating stock and daily transactions of cement shall be kept in each room of the cement store. The cement shall not be stored unduly long periods. It shall not be handled in such a way as to impair its strength or useful characteristics.

3. SAND

Sand shall consist of siliceous material having hard, strong, durable, uncoated particles, free from undesirable amounts of dust, lumbs, soft, or flaky particles or other deleterious substances. The amount of different undesirable substances shall not exceed the percentage

limits by weight as specified in relevant I.S. Codes but in no case, the total amount of all undesirable substances shall exceed five percent by weight.

All fine aggregate (sand) shall conform to I.S. 383-1970.

Sand for use in concrete shall be natural sand. Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay, soft or flaky particles, shale, salts, organic matter, loam, mica or other deleterious substances and shall be approved by the

Engineer. When the quality of fine aggregate is doubtful, it shall be tested for clay, organic impurities and other deleterious substances as laid down in I.S. 383-1970.

The fine aggregate shall be of the sizes as specified below.

a. Cement concrete topping of thickness 40 mm and above - fineness modules between 2 and 3.

b. Cement concrete topping of thickness 10mm and above - fineness modules between 4 and 6.

4. REINFORCING BARS

Reinforcing steel shall be clean and free from loose millscales, dust, loose rust and coats of paints, oil, grease or other coating, which may impair or reduce bond. It shall conform to the following I.S. specifications.

1. Mild steel, Tor steel and medium tensile steel bars and hard-drawn steel wire conforming to IS:432, IS:456, latest revision.
2. Deformed bars conforming to IS:1139 latest revision.
3. Cold twisted steel bars ribbed Tor steel conforming to IS:1786 - latest revision.
4. Hard-drawn steel wire fabric conforming to IS:1566 - latest revision.
5. Structural steel section conforming to IS:226 - latest revision.

All steel reinforcement above 6mm diameter shall necessarily be of tested quality.

6. COARSE AGGREGATE

Coarse aggregate shall consists of crushed or broken stone and be hard, strong, dense, durable, clean and of proper gradation and free from skin and coating likely to prevent proper adhesion of mortar. The aggregate shall generally be cubical in shape and as far as possible flaky, elongated pieces shall be avoided. It shall generally with the provision of I.S. 383-1970 and I.S. 515-1959. Unless special stones from particular quarries are mentioned in the special provision, aggregates shall be broken from the best granite/quartzite/gneiss stones in that order available in the region and approved by the Engineer. Stone shall have no deleterious reaction with cement.

The coarse aggregate shall be of the following sizes:

a. Normal cement concrete of 100mm and above thickness - graded 20mm and below
b. Cement concrete topping thickness 40mm and above - graded from 12mm and below
c. Mass cement concrete of 500mm and above - graded 38mm and below

Aggregate other than crushed stone conforming to the provisions of this Specification may be used under special conditions, if permitted by the Engineer.

Grading tests shall be taken in the beginning and at change of source or material. Where required, by the Engineer, tests indicated in I.S. 383- 1970 and I.S. 456-2000 shall be carried out in an approved laboratory at the Contractor's cost to show the acceptability of the material.

Coarse aggregate of a porous nature where absorption of water after 24 hours immersion in water, is more than 5 percent by weight, shall not be used.

Limits of deleterious substances shall not exceed those prescribed in 2.3.1.1 and 2.3.1.2 of I.S. 515-1959.

The aggregates of different sizes shall be stored separately and handled in such a manner as to prevent intermixing of different sizes of aggregate required separately for grading purposes. No foreign matter shall be allowed to be mixed up with aggregates. If covered with dust etc. they shall be washed clean before use.

Sample of coarse aggregates required for the work shall be approved by the Engineer both regarding the quality and grading and shall be kept in the site office. The coarse aggregates to be used shall conform to these samples.

For controlled concrete, the aggregate shall be supplied in separate batches, consisting at least of coarse, medium and fine gradings. These will then be combined in proportions given by standard grading curves specified in relevant I.S. Codes. An average mix composition of 20mm (3/4") and 38mm (1.5") aggregates that will be obtained from the average standard aggregates grading curves is shown in Table - A.

Table - A

Type of Aggregate	Aggregate Size	Proportion Remarks of Total Mix. by Weight	Remarks
3/4" aggregate (20mm)	3/4" to 3/8" 3/8" to 1/4" Sand	61.5% 38.5% 35.0%	Passing 3/4" must 100%
1½" aggregate (38 mm)	1½" to 3/4" 3/4" to 3/8" 3/8" to 3/16" Sand	37.0% 16.0% 100.0% 34.0%	Passing 1 1/2" seive must be

Note: The above will NOT give a perfect grading. It can be expected, however, that the above grading will normally give good results.

Stone shall be hard, sound, far from decay, durable, tough, free from cracks and decaying. Stones with process matter or with boulder skin shall be rejected. It should be gravels / quartzite / gneiss stone in that order a preferably of similar quality and strength. It should in no case shall have any deleterious reaction with cement.

9. WOOD/VENEER

Ply wood/veneer shall be of 3 or 5 or 7 ply. All such ply wood shall be pressed properly to the required degree and to the required uniformity. They shall be of approved pattern and shall conform to I.S. 1328-1959.

Defective ply wood/veneer either the damaged corner or edge or by defective pressing shall not be used at all.

Storage of such boards shall be done in uniform layer above storey level in a dry platform. No edge shall be contacted with wall while storing.

10. STEEL SECTIONS

Structural steel section shall be as per IS specification and steel tubes used in the truss shall be hot finished tubes confirming to the requirements of specified in IS 1161 - 1968 and IS 807 - 1968. Tubes shall be of grade heavy or medium unless instructed.

11. STONES

The stone shall be of approved quality, sound, hard, dense and durable, free from

segregation, seams, cracks, weathered portion and other structural defects as imperfections tend to affect their soundness and strength. The stone shall be compact grained and uniform in texture and color. The stones shall be free from rounded, wash or weathered surface or skin or coating which prevents the adherence of mortar. The stone shall be free from decay, flaws, veins and holes. The stone shall have a crushing strength of at least 100 kg/sq.cm.

The stone shall stand weathering well and when immersed in water for 24 hours shall not absorb more than 5 % of its dry weight.

The surface of freshly broken stone shall be bright, clean, sharp and shall have uniformity of texture without loose grains and be free from any dull chalky or earthy appearance. Stones showing molted color shall not be used for face work.

The stones shall be kept free from dust, dirt, oil and other injurious materials which may attack the stone or mortar and prevent adhesion of mortar.

Stones shall be properly seasoned by exposure to air before they are put into the structure, as stones increase in durability after quarrying especially limestones, sand stones and laterites. Stones newly quarried contain quarry sap and can more easily be worked in this condition.

Stones to be used as headers, pin headers quoin, copings etc. shall comply with the size and shape stipulated under the relevant item.

Different categories of stones such as face stones, headers, quoins etc. shall be collected in advance to suffice at least a month's requirements and shall be stacked separately category wise.

B2. CONSTRUCTION WORKS

EARTH WORK

1. SCOPE

This specification covers the earth work in excavation for all types of foundation wet or dry.

2. CLEARING SITE

The site on which the structure is to be built as shown on the plan and the area required for setting out and other operations should be cleared and all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood and trees removed as directed, roots being entirely grubbed up. The materials obtained will be the property of the Government and materials pronounced useful by the consultant will be conveyed and properly stacked as directed within the specified lead. Useless materials shall be burnt or otherwise disposed off as directed by the Engineers.

3. SETTING OUT

After clearing the site, the centre lines shall be given by the Engineers and it will be the responsibility of the Contractor to install substantial reference marks, bench marks etc. and maintain them as long as required true to line, curve, slopes and level. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Labour, material etc. required for setting out and establishing Bench Marks and other reference marks shall be arranged by the Contractor at his own cost.

4. EXCAVATION

Foundation excavation shall include removal of all materials of whatever nature and whether wet or dry, necessary for the construction of foundation and substructure exactly in accordance with the lines, levels, grades and curves as shown on the plans or as directed by the Engineers. It shall be taken to the exact width of the lowest step of the footing and the sides shall be left plumb where the nature of soil admits it. Unless there is a specific extra provision in the contract for shoring or for cutting side slopes, contractor shall at his own cost do the necessary shoring or cutting of slopes to a safe angle or both as approved by the Engineers, when the strata need such treatment. The contractor shall notify the Engineers before starting excavation to enable him to take cross sectional level for purposes of measurements before the ground is disturbed.

5. PREPARATION OF FOUNDATION FOR FOOTING

The bottom of foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineers. Before footing is laid final surface shall be slightly watered and rammed. If any soft patches come to light on inspection or ramming, these shall be dug out and dealt with a directed by the Engineers. No filling shall be allowed to bring the foundation to level. If by contractor's mistake, excavation is made deeper than shown on the plans or ordered by the Consultant, the extra depth shall be made up with concrete or masonry of the foundation grade as directed by the Engineers, and at the cost of the contractor. All rock or other hard foundation shall be cleaned of all soft and loose material and out to a firm surface, either level, stepped or serrated as directed by the Engineers. The elevation of the bottom of foundation shown on the plan shall be considered as approximate only and the Consultant may order such changes in the dimensions and elevations of the foundation as may be deemed necessary to secure satisfactory foundation.

After each excavation is completed, the contractor shall notify the Engineers to that effect and no footing shall be allowed to be laid until the Engineers has approved the depth and dimensions of excavation and nature of the foundation material and the levels and measurements are recorded.

6. SHORING

Unless separately provided for in the contract, excavation of slopes to prevent falling in of sides or providing, fixing, maintaining and removing shoring, bracing etc. shall not be paid for. The Contractor shall be responsible for the design of shoring of sufficient strength to resist side pressure and ensure safety from steps and blows and to prevent damage to work and property and injury to persons. It shall be removed as directed after all the items for which it is required are completed.

7. PROTECTION

Near towns and all frequented places foundation pits shall be strongly protected to avoid accidents. 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 by the Contractor at his own cost, he being entirely responsible for any injury to life and damage to property caused by his negligence or accident due to his constructional operations.

8. DISPOSAL OF EXCAVATED MATERIALS

No materials excavated from the foundation trenches of whatever kind they may be, are to be placed even temporarily nearer than 1.5 meters or greater distance as directed by the Engineers from the outer edge of excavation. All materials excavated will remain the property of the Owner. Rate for excavation includes sorting out of useful materials and stacking them separately as directed within the specified lead. Materials suitable and useful for back filling or other use shall be stacked in convenient places but not in such a way as to obstruct free movements of men, animals and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or the elevation shown on the drawings or as directed by the Engineer. For backfilling, the materials shall be placed in 15 to 20 cm layers, moistened and well compacted. Materials not useful in any way shall be thrown as directed by the Engineers. If useful excavated rubble is required by the Contractor for the use in other items, it shall be paid for at the rate fixed in the tender and if not so provided, at the rate at which both parties mutually agree. The site shall be left clean of all debris on completion.

9. DEWATERING

Unless specially provided for as a separate item in the Contract, the excavation rate shall include pumping out all water which may accumulate in the excavation during the progress of the work either from seepage, springs, rain or any other cause and diverting surface flow if any, by bonds or other means. The bonds shall be removed after their purpose is served.

Pumping water from any foundation enclosure or trenches shall be generally in such a manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structures. The excavation shall be kept free form water (i) during inspection and measurement, (ii) when concrete and / or masonry are in progress and till they come above the natural water level and (iii) till the employer considers that the mortar is sufficiently set.

10. SLIPS AND BLOWS

If there are any slips or blows in the excavation, they shall be removed by the Contractor without any extra cost so as to provide correct dimensions required for the foundation.

11. BACK FILLING

All timber work and form work shall be removed after their necessity ceases and trash of any sort shall be cleaned out from the excavation. All space between foundation masonry or concrete and the sides of excavation must be refilled to the original surface with approved materials, in layers of 15 to 20 cm in thickness, watered and rammed to compact.

The filling shall be done after concrete or masonry is fully set and done in such a way as not to cause undue thrust on any part of the structure. Where suitable excavated material is to be used for refilling, it shall be brought from the place where it was temporarily deposited and used in refilling.

12. TYPES OF EXCAVATION

12.1 Ordinary Soil

Soils of all sort, sand, loose gravel, soft clay, black soil and other similar soft or loose materials etc. shall include all materials of earthy or sandy nature which can be easily ploughed or small shingle or gravel which can be easily removed.

12.2 Conglomerate

Gravel mixed soil / hard soil which is to be excavated by the help of pick, Jumper and lifted or removed by the help of shovel.

12.3 Rock / Hard Rock

Large boulder / stone or pebbles formally jointed / cemented which need chisel to brake / excavate.

13. RATE

The rate for the item of excavation shall include the following:

a) Cleaning site.
b) Setting out works, profiles etc. according to the sanctioned plan or as ordered by the Engineers and setting up Bench Marks and other reference marks.
c) Providing and subsequently removing shoring and shuttering or cutting slopes except when separately provided for in the Contract.
d) Bailing and pumping out water when separate provision does not exist for in the contract.
e) Excavation and removal of all materials of whatever nature dry or wet and necessary for the construction of foundation including materials like explosives, removal of blows and slip sand use of tools, plant and equipment necessary for satisfactory completion of the items and preparing bed for foundation.
f) Sorting out of useful excavated materials, conveying them up to the specified lead clear beyond the structure and stacking them neatly for backfilling or reuse and disposing useless materials as directed by the Engineers.
g) Backfilling the trenches alongside masonry or concrete with approved material up to the natural ground level.
h) Necessary protection including labour, materials and equipment to ensure safety and protection against risk or accident.
i) Supply of facilities for inspection and measurement at any time by the Engineers.
j) Compensation for injury of life and damage to property if any caused by the Contractor's operation connected with this item.
k) Small drill holes to explore the nature of substratum if necessary.

14. MEASUREMENT AND PAYMENT

The payment for respective class of excavation shall be made at the Contract rate per cubic meters (cubic foot) for the quantity acceptably excavated, limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The excavation to dimension in excess of the above shall not be measured nor paid for and if so ordered by the Engineers the Contractor shall have to fill up the excess depth with cement concrete or masonry of foundation grade without extra payment.

Driving of sounding bars or inserting small drill holes to explore the nature of substratum up to a total length of 1 meter distributed in 2 or 3 places in each foundation if necessary shall be considered incidental work and shall not be paid for separately.

Removal of slips and blows in the foundation trenches shall not be measured nor paid for. If it is necessary in the opinion of the Engineer to carry foundation below the levels shown on the plans, the excavation for the first 1.5 meters of the additional depth shall be included in the quantity for the particular classification at the tendered rate. The excavation below this additional depth of 1.5 meters shall be paid for as extra work at rate to be decided under general conditions of Contract unless the contractor is willing to accept payment at tendered rates. For all depths less than the designed depth plus 1.5 meters the excavation shall be paid for at tendered rates.

Dimension shall be measured nearest to one centimeter and individual quantity shall be calculated correct to two places of decimals of a cubic meter.

STONE SOLING WORKS

1. SCOPE

This specification covers providing and laying of stones on the base of the excavated trench for walls and columns. This provides platform for concrete to be placed above which wall or/and column will be erected.

2. MATERIAL

The soling stones should be non-amorphous and flat, round stones shall be restricted to use. Tested stones for the strength should be used.Test certificate shall be submitted to the Engineer for approval.

3. PREPARING BASE, PLACING IN POSITION AND CLEANING

Surface for placing soling stones should be compacted well in advance. Soling stones will be placed with minimum voids as far as practicable. Compaction of stones after placing for all of the horizontal base will be accepted.Surface above soling should be plane. Surface should be dust-free to bind with concrete above it.

4. MEASUREMENT

The net soling work shall be worked out in terms of cubic meter as per the measurement upto the bill of quantities.

5. RATE

Rate shall include all material, labour and other incidental items for complete work.

CEMENT CONCRETE WORK FOR GENERAL USE

1. SCOPE

This specification deals with the cement concrete, plain or reinforced for general use of specified proportion and flooring (I.S. Code of Practice IS:456 latest revision to be complied with unless permitted otherwise hereinafter).

2. MATERIALS

All required materials shall be as specified in "STANDARD CONSTRUCTION MATERIALS"

Admixtures: The use of admixtures in concrete for promoting workability improving strength, entraining air or for any other purpose may be used only with the prior approval of the Engineer.

3. GRADES OF CONCRETE

a. General:

Structural concrete shall be either ordinary or controlled and in three grades designated as M15, M20 and M25, as specified in IS:456 - latest provision.

Ordinary Concrete:

Ordinary concrete is recommended only when accurate control is impracticable and not necessary. However, if ordinary concrete is allowed by the Engineer, it shall be used only in the concrete of Grades M15, M20 and M25. Ordinary concrete does not require preparation of trial mixes.

Concrete mix proportions for ordinary concrete shall be as per IS:456 - latest revision - and as follows:

Mix Proportions (By Weight) Expected to Give Different Degrees of

Workability with Different Water Cement Ratios and A

Specified Strength

(For Guidance)

Workability	Water Cement Ratio	Compressive Strength in 28 days kg/cm²	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement to Crushed Stone Aggregate	
			20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	360	1:4.8	1:5.3	1:4.5	1:5.0
Slump	0.5	290	1:7.2	1:7.7	1:6.5	1:7.4
0-25 mm	0.6	220	1:8.5	1:8.6	1:7.8	1:8.4
	0.7	160	1:9.0	1:9.0	1:8.7	1:8.9
Low	0.4	360	1:3.9	1:4.5	1:3.5	1:4.0
Slump	0.5	290	1:5.5	1:6.7	1:5.0	1:5.5
25-50 mm	0.7	160	1:8.0	1:8.5	1:7.4	1:8.0
Medium	0.4	360	1:3.5	1:3.8	1:3.1	1:3.6
Slump	0.5	290	1:4.8	1:5.7	1:4.2	1:5.0
50-100 mm	0.7	160	1:6.8	1:7.9	1:6.2	1:7.0
High	0.4	360	1:3.2	1:3.5	1:2.9	1:3.3
Slump	0.5	290	1:4.4	1:5.2	1:3.9	1:4.6
100-175 mm	0.6	220	1:5.4	1:6.7	1:4.7	1:5.7

	0.7	160	1:6.2	1:7.4	1:5.5	1:6.5

Notwithstanding anything mentioned hereinbefore, the maximum total quantity of aggregates by weight per 50 kg of cement shall not exceed 450 kg except where otherwise specifically permitted by the Engineer.

The minimum cement content for each grade of concrete shall be as follows:

Grade of Concrete	Minimum Cement Content per Cum of Finished Concrete
M 15	325 kg.
M 20	360 kg.
M 25	420 kg.

At least six test cylinders/cubes are taken for each batch noting the slump on each mix. These cylinders/cubes shall be tested in a testing laboratory approved by the Engineer at 7 days and others at 28 days for obtaining the ultimate compressive strength. The test reports shall be submitted to the Engineer. The cost of the mix design and testing shall be borne by the Contractor.

On the basis of the above test reports, proportion of mix by weight and water-cement ratio will be approved by the Engineer, the proportions so decided for different grades of concrete shall be adhered to during all concreting operations. If, however, at any time, the Engineer feels that the quality of the materials being used, has been changed from those used for preliminary mix design, the Contractor shall have to run similar trial mixes design, the Contractor shall ascertain the mix proportions and water-cement ratio for obtaining the desired strength and consistency. It will be within the competency of the Engineer to reduce the number of trial batches and the number of test specimens mentioned above.

The mixes once approved must not be varied without prior approval of the Engineer.

In designing the mix proportions of concrete, the quantity of both cement and aggregate shall be determined by weight. The Engineer may allow the quantity of aggregates to be determined by equivalent volume basis after the relationship between the weight and volume is well established by trial and the same shall be verified frequently. Water shall be either measured by volume in calibrated tanks or weighted.

All measuring equipments shall be maintained in a clean and serviceable condition and their accuracy periodically checked.

To keep the water-cement ratio to the designed value, allowance shall be made for the moisture content in both fine and coarse aggregates and determination of the same shall be made as frequently as directed by the Engineer. The determination of moisture contents shall be according to IS: 2386 (Part III) - (latest revision).

4. STRENGTH REQUIREMENTS

Where ordinary portland cement conforming to IS: 269 - latest revision or Portland cement-Furhance Slag cement conforming to IS: 455 - (latest revision) is used, the compressive strength requirements for various grades of concrete shall be as shown in Table - IV and shall apply to both controlled concrete and ordinary concrete.

The acceptance of strength of concrete shall be as per clause 5.4 "Sample size and Acceptance Criteria" of IS: 456 - latest revision subject to the stipulations and/or modifications stated elsewhere in this specification.

Concrete work found unsuitable shall have to be dismantled and replacement to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement embedded fixtures, etc shall be made. In course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good free of charge by the Contractor to the satisfaction of the Engineer.

Compressive strengths for different grades of concrete as specified in Table - IV shall always refer to the cylinder/cubes strength based on test conducted on 15 cm diameter and 30 cm height.

Other requirements of concrete strength as may be desired by the Engineer shall be in accordance with IS:456 - (latest revision).

In exceptional circumstances, the Engineer may accept a concrete of lower strength than specified and which is otherwise unacceptable according to the "Acceptance Criteria" of IS:456 - (latest revision), provided the strength is never less than 80% of the specified strength. All concrete having a strength less than 80% of that specified shall always be rejected. Payment for concrete of lower strength than specified but accepted by the Engineer shall always be made at a reduced rate on prorata basis to the strength obtained.

Strength Requirement of Concrete

Grade of Concrete	Compressive strength of 15 cm. diameter and 30 cm. high cylinder or 15 cm cube at 28 days after mixing, conducting in accordance with IS: 456 - latest revision	
	Preliminary tests N/mm^2	Work test N/mm^2
M 15	20	15
M 20	26	20
M 25	32	25

With permission of the Engineer, for any of these above mentioned grades of concrete shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment for the additional cement will be made.

5. WORKABILITY

The workability of the concrete shall be checked at frequent intervals by slump test. Where facilities exist and if required by the Engineer, alternatively, the compacting factor test in accordance with IS: 1199 - (latest revisions), shall be carried out. The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formworks and around on the type and nature of structure and shall be based on experience and tests within the preferred limits of consistency as specified in Table below for various types of structures.

Limits of Consistency

Degree of Workability	Slump in mm		Use of which concrete is suitable
	Min	Max.	
Low	20	40	Mass concrete foundations without vibrations, simple reinforced section with vibration.
Medium	50	100	Normal reinforced beams, columns, slabs without heavily reinforced section with vibration.
High	100	150	Section with congested reinforcement not normally suitable for vibration.

Note: However, the slump to be obtained for work in progress shall be as per direction of the Engineer.

6. WORKMANSHIP

a. General: All workmanship shall be according to the latest and best possible standards.

Concrete:

i Mixing of Concrete:

The proportion of fine and coarse aggregate, cement and water shall be as determined by the preliminary tests or according to fixed proportions in case of ordinary concrete and shall always be approved by the Engineer. The quantities of fine and coarse aggregates shall be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregates for which regular check shall be made by the Contractor. Due allowance shall be made for bulking in case of volume batching in accordance with I.S. 2386 (Part III) - (latest revision).

Concrete shall be always mixed in a mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant structure. The water shall not be poured into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform in colour and consistency, but in no case shall mixing be done for less than two minutes and at least forty revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixer shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredient for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used and it shall be immediately removed from site.

Each time the work stops, the mixer shall be thoroughly cleaned and when the next mixing commences, the first mix shall have 10% additional cement at no extra cost to the Employer to allow for loss in the drum.

When hand mixing is permitted by the Engineer for concrete to be used in unimportant structures, 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 colour and consistency. In case of hand mixing, extra cement @ 10% shall be added to each batch with no extra cost to the owner.

ii Conveying Concrete:

Concrete shall be handled and conveyed from the place of mixing to the place of final deposit as rapidly as practicable by approved means before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. If segregation does occur during transport, the concrete shall be remixed. During the very hot or cold weather, if directed by the Engineer concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation and loss of heat. Conveying equipment for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

iii Placing Concrete:

Form work and reinforcement shall be approved in writing by the Engineer prior to placing of concrete. Concrete shall be placed in its final position without segregation. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. The interval between adding the water to the dry materials in the mixer and the completion of the final placing inclusive of compaction of the concrete shall be not more than initial setting time of the cement, normally 30 minutes for ordinary portland cement. The concrete shall be well placed in the form work by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop above 180 cm shall have to be approved by the Engineer. Once the concrete is placed in its final position, it shall not be disturbed. After the concrete has been placed, it shall be spread and thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibration shall not be used for pushing and shoveling concrete. Vibrator must be operated by experienced men and over vibration shall not be permitted. Hand tamping in some cases may be allowed subject to the approval of the Engineer.

No concrete shall be placed in open, while it rains. If there has been any sign of separation of cement and sand by washing, the concrete shall be entirely removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete at site. No accumulation of water shall be permitted on freshly laid concrete. Slabs, beams and similar members shall be poured in one operation normally. Bleeding of under layer, if any shall be effectively removed. Moulding, throating, drip coarse, etc. shall be poured as shown on the drawing or as directed by the Engineer. Holes shall be provided and bolts sleeves, anchors fastenings or other fixtures shall be embedded in concrete as shown on the approved drawings or as directed by the Engineer. Any deviation there from the drawing shall be set right by the Contractor at his own expense as instructed by the Engineer.

v Protection and Curing of Concrete:

Newly placed concrete shall be protected by approved means from rain, sun and wind. As soon as the concrete has hardened sufficiently for the surface to be marked, it shall be covered either with sand, hessian, canvas or similar materials and kept continuously wet for at least fourteen days after final setting. This period may be extended at the discretion of the Engineer.

vi Control Tests on Concrete:

Six test cylinders/cubes for each type of work shall be taken by the Contractor for each 8 hours or less of concreting. If the value of concrete poured is less than 20 M3 on any day per mixing plant, the Engineer may exempt or reduce the number of test cylinders. The samples of concrete, shall be tested in an approved laboratory in presence of the Engineer and the test results shall be submitted in triplicate to the Engineer. The Contractor shall carry out the sampling and testing according to the provisions of this Specification at his own cost. No payment shall be made for the concrete used in specimens.

To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor free of charge every two hours or as directed by the Engineer. The amount of mixing water shall not be changed without prior approval of the Engineer. Slumps corresponding to the test cylinders shall be recorded for reference. The Engineer if he so desires may order special tests to be carried out on cement, sand or coarse aggregates, water reinforcing steel, or traverse tests in accordance with I.S.I. recommendations. If the material tested is found to be suitable for the intended use, the cost of these special tests shall be borne by the Owner. If the material is found to be not suitable for the intended use, the cost of these special tests shall be borne by the Contractor. Further, during the progress of the work if the Engineer has doubt about the quality of any material in use he can instruct suspension of its use till the material is proved acceptable by test. Any consequent loss arising out of the suspension shall be borne by the Contractor.

8. RATES

The rates for items shall include cost of all materials consumed in the work at all levels, hire charges of materials, tools and plant, cost of labour, insurance, all transport, services, accommodation, supervision, storage, protection etc. complete.

9. MEASUREMENT AND PAYMENT

The payment for respective class of concrete shall be made at the Contract rate per cubic meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The concrete to dimension in excess of the above shall not be measured nor paid for. The dimensions for measurement shall be the concrete excluding any finishes. The size shall be measured correct up to 12 mm and content worked out in cubic meter.

NON STRUCTURAL CONCRETE (LEAN CONCRETE)

1. SCOPE

This specification deals with the plain cement concrete for lean concrete works for general use of specified proportion.

2. MATERIALS

All required materials shall be as specified in "STANDARD CONSTRUCTION MATERIALS"

3. WORKMANSHIP

All workmanship shall be according to the latest and best possible standards.

Non-structural concrete will be designated by their volume ratio 1:3:6. These concrete act only as platform and as such are assumed to have no structural strength. Concrete of this class are proportioned according to its volumetric ratios and may be hand mixed. The maximum size of aggregates for this type of concrete shall be 20 mm. Non-structural concrete shall be batched and mixed in the following manner:

Cement and aggregates shall be batched by volume and mixed together to a uniform consistency until the cement color can no longer be distinguished. Water shall be added by approved means while undergoing further mixing and within two minutes, the mix shall be worked up to a homogeneous mass to a workability approved by the Engineer.

Boxes for volume batching of non-structural concrete shall be filled without tamping, ramming, or consolidation of any kind (other than occurring naturally during filling process), and shall be screeded off level with their topmost edges.

Mix shall be prepared and used in quantities that no more than 30 minutes shall elapse between the first wetting and complete use. Under no circumstances shall any of the stiffened concrete be used. Fresh concrete shall not be mixed with those prepared earlier and all batches shall be used separately.

Non-structural concrete shall be placed and then compacted by gentle ramming with a metallic rammer so that work can commence on it within 24 hours. If work cannot commence as stipulated, it shall be cured as per provisions of structural concrete.

4. RATES

The rates for items shall include cost of all materials consumed in the work at all level, hire charges of materials, tools and plants, cost of labour, cost of side forms, insurance, all transport, services, etc, complete.

5. MEASUREMENT

Measurement of works will be made in cubic meter or as specified in bill of quantities.

CENTERING AND SHUTTERING FOR RCC WORK

1. SCOPE

This specification covers centering and shuttering works for RCC works of any size, shape etc. at only level including strutting, propping and removal thereof.

2. MATERIAL

Form work shall be composed of steel or shuttering plywood. Timber shall be free from knots and shall be of medium grain as far as possible. Hard woods shall be used as caps and wedges under or over posts. Plywood or equivalent shall be used where specified to obtain smooth surface for exposed concrete work. Struts shall generally be mild steel tubes and strong sal ballahs 150mm in diameter or above. Bamboos, small diameter ballahs, etc. shall never be used unless specially approved by the Engineer in specified cases.

3. SHOP DRAWING

The Contractor shall prepare, design and drawings for formwork and centering before commencement of actual work and get them approved by the Engineer. The form work and centering shall conform to the shape, lines and dimensions as shown on the drawings.

4. CONSTRUCTION

The centering shall be true and rigid and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid and working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging distortion or shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure the concrete a smooth uniform surface free from honeycombs, air bubbles, fines and other blemishes.

Any blemishes or defect found on the surface of the concrete must be brought to the notice of the Engineer and immediately rectified free of charge as directed or approved by the Engineer. Where there are chances of fixtures being embedded, only mild steel or concrete of adequate strength shall be used.

For exposed concrete surface of columns, plywood or other approved forms, thoroughly created and tied together with approved corrosion-resident divides shall be used. Rigid care shall be exercised in ensuring that all columns are plumb and true and thoroughly cross braced to keep them so.. Unless described in the drawing or elsewhere to the contrary, beveled strips 25mm by 25mm shall be provided without any extra charge, to form angles and in corners of column for chamfering of corners. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently concerted.

5. CLEANING AND TREATMENT OF FORMS

All rubbish, loose concrete chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before the concrete is poured. Wire brushes, brooms, etc. compressed air jet and/or water jet shall be kept handy for the cleaning if directed by the Engineer.

The form surface in contact with concrete shall be treated with approved non-staining composites, such as approved brand form oil. It shall not come in contact with reinforcing steel or existing concrete surface. They shall not be allowed to accumulate at the bottom of the shuttering.

If formwork for column is erected for the full height of the columns, one side shall be left open

and built up in sections, as placing of concrete proceeds. Wedges, spacer bolts, clamps, or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jarring the concrete.

6. REMOVAL OF FORMS

The Contractor shall record on the drawing or in some approved manner, the date on which the concrete is placed in each part of the work and the date on which the formwork is removed therefrom and have this record checked and countersigned by the Engineer. The Contractor shall be responsible for the safe removal of the formwork, but the Engineer may delay the time of removal, if he considers it necessary. Any work showing signs of damage through premature removal of formwork or loading shall be entirely reconstructed without any extra cost of the owner.

Forms for various types of structural component shall not be removed before the minimum periods specified below, which shall also be subjected to the approval of the Engineer.

Ordinary Portland Cement Concrete (Temp ^{o}C)				Rapid Hardening Portland Cement Concrete(Temp ^{o}C)	
Part of Structure	40 – 20 Days	20 – 5 Days		40 – 20 Days	20 – 5 Days
a. Columns & Walls	1	2	Do not remove forms unit	1/2	2

Where exposed surface of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40^{o} C can be reduced to those for the temperature range of 20^{o} C to 40^{o} C subject to the approval of the Engineer. Before removing any form work the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires.

7. TOLERANCE

The formwork shall be so made as to produce a finished concrete true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerance unless otherwise specified elsewhere in this specification or drawings or directed by the Engineer.

For:

a.	Sectional dimension	-	5 mm
b.	Plumb	-	1 in 1000 of height
c.	Levels	-	3 mm before any deflection has taken place.

8. RE-USE OF FORMS

Before re-use, all forms shall be thoroughly scraped, cleaned, joints etc. examined and when necessary repaired and inside surface treated as specified hereinbefore. Formwork shall not be used / re-used, if declared unfit or unserviceable by the Engineer.

9. CLASSIFICATION

Ordinary exterior grade plywood of good quality shall be used for formwork. Where a specially good finish is required and shall be made mostly of approved brand of heavy quality plywood to produce a perfectly level, uniform and smooth surface. Re-use only may be permitted after

special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class.

10. RATE

Rate shall include for all necessary material and labour to execute the formwork.

11. MEASUREMENT AND PAYMENT

The payment for respective type of formwork shall be made at the Contract rate per square meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The concrete to dimension in excess of the above shall not be measured nor paid for. The dimensions for measurement shall be the area contacting to concrete. The size shall be measured correct up to 2 decimal places and content worked out in square meter.

REINFORCING FOR RCC WORKS

1. SCOPE

This specification covers providing and fixing High Strength Steel and Mild steel reinforcement of various sizes in all type of R.C.C. works.

2. MATERIAL

The reinforcement shall be as specified in the STANDARD CONSTRUCTION MATERIAL and test certificate shall be submitted to the Engineer for approval. Each reinforcing bars shall be tested and any bar showing cracks or flows or scales shall not be used.

3. SHOP DRAWINGS: BAR BENDING SCHEDULES

The Contractor shall furnish to the Engineer bar bending schedules for all R.C.C. work in triplicate within one month of the receipt of the Letter of Intent or of the receipt of each design drawings whichever later. Upon receipt of the Engineer's final corrections as corrected, contractor shall submit six prints of the approved drawings/schedules. Approval of schedule/drawing by the Engineer shall not relieve the Contractor from responsibility for errors nor relieve him of any part of his obligation to meet all the requirement of the Contractor or of the responsibility for the correctness of his drawings.

4. CLEANING

All steel for reinforcement shall be free from loose rust, oil grease, paint or other harmful matters.

5. BENDING

Unless otherwise specified, reinforcing steel shall be bent in accordance with procedure specified in IS:2502 - (latest revision) or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions in the approved Bar Bending Schedule. Contractor shall be entirely responsible for its correctness. Bars correctly bent shall only be used. No reinforcement shall be bent when in position in the work without approval of the Engineer, whether or not is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the materials. Re-bending can be done only if approved by the Engineer. Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved.

6. PLACING IN POSITION

All reinforcement shall be accurately placed in position as shown on the drawings. Bars intended to be in contact, at crossing points, shall be securely bound together at all such points by No. 20 BG annealed soft iron wire or by tack welding as may be directed by the Engineer .

Binders and the like shall be tightly embraced the bars with which they are intended to be in contact
and shall be securely held. The vertical distance between successive layers of bars shall be placed by provision of mild steel spacer bars. They should be so spaced that the main bars do not sag perceptibly between adjacent spaces.

Welding by gas or electricity may be permitted by the Engineer under suitable conditions and with suitable safe guards in accordance with relevant I.S. But welding between ends of a bar in line whereby stress is transferred across the section may be allowed for mild steel bars only.

The placing of reinforcement bars shall be completed well in advance of concrete pouring. The reinforcement shall be checked by the Engineer for accuracy of placement and

cleanliness and necessary corrections prior to pouring the cement. Concrete blocks shall be used for ensuring the cover and positioning of reinforcement, they shall be made of mortar of mix one part cement to two parts sand by volume and cured for at least seven days. The sizes and locations of concrete blocks shall be as approved by the Engineer. Anchorage lengths of reinforcing bars shall be in accordance with IS:456 - latest revision- unless otherwise specified.

7. COVER TO THE REINFORCEMENT

Cover to the reinforcement shall be 50 mm for column and wall band.

8. MEASUREMENT

The net reinforcement work shall be work out in term of weight as per the bar bending schedule approved by the Engineer, taking theoretical unit weight for various size of the bars.

9. RATE

Rate shall include all material, labour and other incidental items for complete work.

STONE MASONRY WORK

1. SCOPE

This specification covers the construction of stone work in general and the erection of 16 inches thick walls in foundation and superstructure.

2. MATERIALS

All required materials shall be as specified in the "STANDARD CONSTRUCTION MATERIALS".

3. MORTAR

Mortar shall be as specified in the drawing, Bills of quantities or schedule of items for the particular work.

a. Mix:

Cement and sand shall be mixed dry thoroughly on clean approved platform or in a mechanical mixer and water shall then be added to obtain a mortar of the consistency of a stiff paste. Care being taken to add just sufficient water for the purpose.

b. Use of Mortar:

Mortar shall be used as soon as possible, after mixing and within 1/2 hours after cement is mixed wet. Mortar unused for more than 1/2 hours shall be rejected and removed.

c. Transportation of Mortar:

The well mixed mortar shall be transported from the mixing platform to the site of work in such a manner as to prevent formation of laitance or segregation.

4. BOND

Random Rubble Masonry shall be used in the construction of walls.Special care should be taken for non-verticality of joints in the masonry, provision of corner stones,staggering of joints and provision of thorough stones. Holes for inserting MS angles inside the wall should be carefully prepared without disturbing the bond. After they are fixed, the extra hollow left in the holes shall be filled.

5. THICKNESS OF JOINTS

The thickness of the joints in the stonework shall be 8mm unless otherwise specified and uniform throughout the work.

6. CLEANING OF STONES

Any dirt, sand and dust shall be removed from the surface of the stones. Stones shall not be too wet at the time of use, as they are likely to slip in the mortar bed and there will be difficulty in ensuring plumpness of the wall.

7. LAYING OF STONES FOR MASONRY

Stones shall be laid on a full bed of mortar evenly applied on the surface of the stone work. If any dirt or earth is on the wall they shall be cleaned by wire brush and washed down with water jet. When laying, the stones shall be slightly pressed so that the mortar can get into all the pores of the stone surface to ensure proper adhesion. Cross joints and wall joints shall be properly flushed and packed with mortar so that no hollow spaces are left. All stone work shall be in plumb, square and true to dimensions as shown in drawings. All stonework shall be built tightly against columns with proper distance to permit concealed joints.

8. RAKING OUT JOINTS

Joints of stone work shall be raked out to a depth of 6mm at the time of laying. The face of the stone work shall be kept clear of all mortar, the very day the brick work is laid.

9. REINFORCING AND ANCHORAGE

For walls, rods coming from columns shall be adequately embedded in the masonry.

10. WORKMANSHIP

a. All loose materials, dirts, and set lump of mortars may be laying over the surface over which the stone work is to be freshly started, shall be removed with a wire brush.
b. All the stones shall be thoroughly soaked in clean water before use.
c. The surface over which the stone work is to be started shall be slightly wetted.
d. The first course itself shall be made horizontal by providing enough mortar in the bed joint to fill up any undulations in the bed course.
e. Required quantity of water is mixed in the mixing platform itself and not over the courses.
f. The joint should be of uniform thickness as specified.
g. The verticality and horizontality of the courses shall be checked very often with plumb bob and spirit level respectively.
h. The courses of stone work shall be aligned and care shall be taken to keep the perpends.
i. The stone work shall be built in uniform layers, corners and other advanced works shall be racked back.

11. CURING AND PROTECTION

a. The stone work shall be kept wet for 7 days commencing from 24 hours after the course is laid.
b. at the end of the day's work the masonry construction shall be protected from harmful effects of rain, sun, and frost by suitable coverings such as tarpaulin or any other suitable coverings.

15. RATES

Rates for item shall include necessary materials, labour and equipment for proper execution of work and that all auxiliary work is included. Rates shall include work at all the levels and conveyance of materials etc. Rates shall also include for curing.

16. MEASUREMENT AND PAYMENT

The payment for respective type of stone work shall be made at the Contract rate per cubic meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The lift of stone work in superstructure shall be upto 6 m above ground level. Deductions of all openings in the brickwork shall be done to arrive the net quantity. However nothing extra shall be paid for making such openings and scaffoldings.The size shall be measured correct up to 2 decimal places and content worked out in cubic meter

WIREMESH, BARBED WIRE AND MS ANGLE WORKS

1. SCOPE

This specification covers supply, fabrication, and installation of wiremesh fencing above wall superstructure, barbed wire (GI) and MS angles.

2. MATERIALS

Wiremesh: **Wiremesh used for the work shall be of wire (medium) -10, mesh size 60*60 mm, 3 feet high**

Barbed Wire: **GI barbed wire fence of 12 SWG**

MS Angle*:* **25*25*6 mm size MS angle.**

3. FABRICATION AND INSTALLATION

Wiremesh shall be tied with MS angles throughout the wall using binding wire of good quality above the wall.Barbed wires are tied at the top of MS angle above wiremesh.MS Angles are to be inserted inside the columns and wall, 60mm, suitably providing holes for insertion in case of wall while construction of wall and at the time of casting in case of columns.Concreting inside the hole of the wall should be done immediately after the insertion of MS Angle.

4. RATE

The rate for the items shall include all labour, materials, use of tools and machinery inclusive.

6. MEASUREMENT AND PAYMENT

Measurement and payment shall be done in running meter for wiremesh and barbed wire and in kgs for MS angles. Measurement shall be done nearest to two decimal places separately for these types of the work for the net quantity executed.

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