



MAZAGON DOCK SHIPBUILDERS LIMITED

(Formerly known as Mazagon Dock Ltd.)

CIN : U35100MH1934GOI002079

(A Government of India Undertaking)

Dockyard Road, Mazagon,

Mumbai 400 010.

INDIA

CIVIL & FIRE WATER HYDRANT WORK

GENERAL TECHNICAL SPECIFICATIONS

&

APPROVED MAKES

VOLUME-IV

CIVIL WORK

SECTION	SUBJECT	Page No.
1	STANDARD TECHNICAL SPECIFICATIONS FOR CIVIL WORKS	3
2	CONTENTS OF A - CIVIL WORK	12
	SPECIFICATIONS	14
1	Excavating Foundations	14
2	Filling in with Contractor's Earth or Murum	15
3	Dry Rubber Packing	16
4	Cement Concrete in Foundation and Bedding	17
5	Sand and Mortar	17
6	Stone and Brick Masonry work in General	17
7	Brick & Brick Work in General	18
8	Cement Plaster	19
9	Sand faced Cement Plaster	20
10	Specification for plain, Reinforced and Prestressed concrete	20
11	Specification for the use of Plastic cover Blocks	31
12	Mixing and Placing of Concrete	32
13	Removal of centring	34
14	Painting	34
15	Chlorinated Polyvinyl Chloride Pipes	37
16	Trenches	44
17	Laying & Jointing cement	45
18	Laying & Jointing Stone ware pipes	46
19	Mode of Measurement	49
20	Testing samples of Cement concrete	51
21	Additional condition / Directions to the Tenderers using ready mixed concrete	53
22	Approved Vendor List	55

STANDARD TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

1. **SCOPE:**
This specification gives a general description of the works to be executed and a detailed description of the materials and workmanship to be used therein. The specification shall be read in conjunction with the other documents forming part of the contract as these documents are jointly explanatory and descriptive of the works included in the contract.

2. **CONTRACT DRAWINGS :**
 - 2.1 The drawings referred to in the Conditions of Contract are listed in List of Drawings annexed herewith but they shall be held to include also all further modified and additional drawings that may be issued to the Contractor by the Employer/Consultants from time to time or approved by him under the terms of the contract.

 - 2.2 The Contractor shall note that the drawings are secret and the property of the employer and hence shall be treated with the requisite confidentiality and shall not be passed on to any third party either in whole or in part. This restriction shall apply even after the works are complete.

 - 2.3 **AS-BUILT DRAWINGS:**
The Contractor shall prepare and submit the Client / Consultants for approval detailed Shop drawings of All Architectural and Structural drawings on completion of contract/work.

3. **BENCH MARKS :**
For the setting out and levelling of the works, the Employer/Consultant shall prior to the commencement of the works provide one levelling bench mark and base line. It shall be the responsibility of the Contractor thereafter to protect these from damage and movement during the entire duration of the contract.

4. **PUBLIC BODY FORMALITIES:**
Set of approved plans would be displayed at site and work would be strictly in accordance with the same. The requirements of all public bodies like keeping the site clean, free from mosquitoes and all other ancillary requirements like labor insurance, maintenance of various registers for laborers, fair wages etc. will be the sole responsibility of the contractor. The Contractor shall assist owner/consultant in obtaining statutory permissions.

5. **CO-OPERATION WITH OTHER AGENCIES:**
The Contractor is reminded that the work to be carried out by him under this contract is the complete work and it is his full responsibility to co-ordinate with any other specialized agencies as may be engaged on work such as electrical , fire fighting agency in the neighbourhood of and even on the site, which work is essential to the progress and may form a continuation. The Contractor must therefore take into consideration and make all allowances, which he may have to undergo in consequence thereof, and for the time, which other persons may require to complete section of their work, which are essential to his progress. The Contractor must accordingly plan and arrange his work and proceed therewith in such a way as to cause the least possible interference and delay from the operations of others, or cause the least possible interference or delay to such others.

6. **LABOUR CAMP:**

No labour camp shall be allowed in MDL premises. Only temporary toilet arrangement should provide by contractor inside the premises with proper drainage facility. The same is to be dismantled after completion of work.

7. **PLAN OF OPERATIONS:**

Before commencing the works the Contractor shall supply to the Consultant for his approval:-

- a. General information of all constructional, pumping, washing of sand and aggregate, excavating, haulage, erection and other plant and equipment.
- b. Drawings showing the general arrangements of his temporary buildings, access roads and other temporary works.
- c. Provisions for dealing with water encountered on the works.
- d. Order in which he proposes to execute the temporary and permanent works to be indicated by diagrams and descriptions. This will be subject to adjustment and approval by the Consultant Bar charts and PERT CPM charts.
- e. Any other item of specific relevance to the contract if requested by the Consultant.

8. **STANDARD SPECIFICATIONS:**

Unless specifically mentioned otherwise all the relevant codes and standards published by the Indian Standards Institution and all other codes/standard which may be published by them before the acceptance of the contract shall apply and govern in respect of design, workmanship, quality and properties of materials and testing.

9. **SAFETY REGULATIONS:**

10.1 **GENERAL:**

Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Employer's safety rules as set forth herein.

10.2 **SAFETY REGULATIONS:**

In respect of all labour, directly or indirectly employed in the work for the performance of Contractor's part of this agreement, the Contractor shall at his own expense arrange for all the safety provisions as per safety codes of Indian Standards Institution, statutory requirements of Factory Building Act and all other statutory requirements, Regulations, Rules, and orders made there under and such other acts as applicable. Special attention shall be given to the various provisions of safety codes of Factories Act, 1948 & statutory amendments or modifications enforced time to time.

The Contractor shall observe and abide by all safety, fire safety regulations adopted by the Employers. Before starting construction work, Contractor shall consult Employers safety Security officer and must make good to the satisfaction of the Employer any loss or damage due to fire to any portion of the work done or to be done under this contract or to any of the Employer's existing property.

The Contractor shall organize his operations in a workmanlike manner and take all necessary precautions to provide safety and prevent accidents on the site to both person and property. The Consultant shall have the power to require the Contractor to adopt from time to time such measures as he may consider necessary to ensure the above requirement.

Safety Regulations:

- (i) All personnel of the Contractor working within the plant site shall be provided with safety helmets, safety shoes, goggles, gloves and Safety Harness for working at height. All welders shall wear welding goggles while doing welding work and all metal workers shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses.
- (ii) Adequate precautions shall be taken to prevent from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.
- (iii) Contractor shall maintain first aid facilities for his employees and those of his sub-Contractors.
- (iv) All critical, industrial, reportable and fatal injuries shall be reported promptly to Employers first and then to Factory Building inspector's office and police department and a copy of Contractor's report covering each personal injury requiring the attention of a physician shall be furnished to the Employers. A Contractor shall take all necessary action to ensure the compliance of statutory requirements of said authorities. Contractors shall settle all such incidences and keep the Employer indemnified against complications arising out of the same.

10.3 **GENERAL RULES:**

Smoking within the Work Area, is strictly prohibited. Violators of the "No Smoking" rules shall be discharged immediately.

10.4 **CONTRACTOR'S BARRICADES:**

- i) Contractor shall erect and maintain at his own cost barricades required in connection with his operation to guard or protect the entire working area including storage, sea fronts and site offices etc.

- ii) Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns at night.
- iii) Complete Construction site shall be barricaded by contractor without any extra cost. Temporary barricading shall be done for minimum 6.0 mt height using Colour coated GI sheets with proper supporting system and shall have wicket gate and material gate. Security shall be provided to all gates to control the entries without any extra cost.
- iv) The Contractor shall also comply with the provisions of Environment Protection Act with regards to air, water & noise pollution.
- v) The contractor shall provide suitable safety net to prevent damage to man / material at site.
- vi) Contractor's employees and those of his sub-Contractors shall become acquainted with Employer's barricading practice and shall respect the provisions thereof.
- vii) Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns at night.
- viii) Complete Consturction site shall be barricaded by contractor without any extra cost. Temparary barricading shall be done for minimum 3.0 mt height using GI sheets with proper supporting system and shall have wicket gate and material gate. Security shall be provided to all gates to controle the entries without any extra cost.

10.5 **SCAFFOLDING: ALL SCAFFOLDS ARE STEEL DOUBLE LEG WITH HORIZONTAL MEMBERS AT EVERY THREE FEET AND PROPERLY TIED LATERALLY WITHOUT MAKING HOLES IN THE MASONRY.NO EXTRA PAYMENTS SHALL BE ENTERTAINED TOWARDS THIS AND CONTRACTOR'S RATES SHALL BE INCLUSIVE WITH THESE CONDITIONS.**

- i) Suitable scaffoldings shall be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period works as can be done safely form ladders. When a ladder is used a Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable foot-holds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical)
- ii) Scaffolding or staging more than 4 meters above the ground or floors swing or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise retarded at least one meter high above the floor or platform of such scaffolding or staging and extending along with entire length of the outside the ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. Only steel scaffolding

with 'H' frames and double support, properly braced shall be allowed to be used.

- iii) Working platform, gangways and stairways shall be so constructed that they should not sag unduly or unequally and if the height of the platform of gangway or the stairway is more than 4 meters above ground level or floor level, they should be closely boarded, should have adequate width and should be suitable fastened as described in (ii) above.
- iv) Every opening in the floor of a building or in a working platform is provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 meter.
- v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length. The width between the side rails in run ladder shall in no case be less than 30 cm for ladder up to and including 3 meters in increased at least 15 mm for each additional meter of length. Uniform step spacing shall not exceed 30cms. Adequate precautions shall be so stacked or placed as to cause danger or inconvenience to any person or public. The Contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defence of every suit action or other proceedings of law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the Contractor be compromise any claim by any such person.
- vi) The Contractors shall give all technical details about scaffolding systems before erecting the same and only after obtaining specific sanction from Client/client/consultants shall erect the same. In any case all the responsibility of safety aspect shall be borne by Contractors only.

10.6 **EXCAVATIONS AND TRENCHING:**

All trenches 1.2 meters or more in depth shall at all times be supplied with at least one ladder for each 5 M length or fraction thereof.

Ladder shall be extended from bottom of the trenches to at least 1 meter above the surface of the ground. The sides of the trenches which are 1.5 meters in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 meters of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under-cutting shall be done.

10.7 **GENERAL SAFETY:**

- i) Before any demolition work is commenced and also during the process of the demolition work,
 - a. All roads and open areas adjacent to the work site shall either be closed or suitably protected.

- b. No electric cable or apparatus, which is liable to be a source of danger, shall remain electrically charged.
 - c. All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
 - d. All persons connected with the execution of works shall wear safety helmets, safety shoes, gloves, safety belts, shields, goggles and protective appliances, safety ladders, platforms etc. to the specific requirements of the work.
 - e. Suitable screens, curtains (plastic mesh or fabric) shall be provided. The same shall be maintained in good condition at all times.
- ii) All necessary personal safety equipments as considered adequate by the CLIENT/CONSULTANTS shall be kept available for the use of the persons employed at the site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by persons concerned as outlined below:
- a. Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.
 - b. Those engaged in white washing and mixing or stacking of cement bags or any materials, which are injurious to the eyes, shall be provided with protective goggles.
 - c. Those engaged in welding and cutting works shall be provided with protective face and eye-shields, hand gloves etc.
 - d. Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
 - e. When workers are employed in sewers and manholes which are in use, the Contractor shall ensure that the manhole covers are opened and are ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accidents to the public.
 - f. The Contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.
 - 1. No paint containing lead or lead product shall be used except in the form of paste or ready-made paint.
 - 2. Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
 - 3. Overall shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash them on cessation of work.
- iii) When the work is done near any place where there is a risk of drowning all necessary safety equipments shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

- iv) Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standard or conditions: -
- a. These shall be of good mechanical construction, should materials and adequate strength and free from patent defects and shall be kept in good working order.
 - b. Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.
 - c. Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to the operator.
 - d. In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be marked with the safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.
 - e. In case of departmental machine, the safe working load shall be notified by the CLIENT/CLIENT/CONSULTANTS. As regards Contractor's Machine, the Contractor shall notify the safe working load of the machine to the CLIENT/CLIENT/CONSULTANTS whenever he brings any machinery to site of work.
- v) Motors, gears, transmission lines, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards. Hoisting appliances shall be provided with such means as to reduce to the minimum the accidental descent of the load, adequate precautions should be taken to reduce the minimum the risk of any part or parts of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel such as gloves sleeves and boots as may be necessary shall be provided. The workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.
- vi) All scaffoldings, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffoldings, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near place of work. The Contractor shall indemnify the Employer against any damages whatsoever arising due to injury sustained by any person because of no provision of adequate barricades/fencing and lighting arrangements.
- vii) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work spot. The person responsible for compliance of the safety code shall be named therein by the Contractor.
- viii) All safety measures for constructional activities shall be as per BIS, unless and otherwise as stated.

- ix) All ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be opened to inspection by the welfare officer of the company or CLIENT/CLIENT/CONSULTANTS or their representatives.
- x) Notwithstanding the above clauses there is nothing in these to except the Contractor from the operations of any other ACT or rules in force in the Republic of India. The works throughout, including any temporary works, shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic in any roads or footpaths at the site or in vicinity thereto or any existing works whether the property of the Employer or of a third party.

10.8 **CARE IN HANDLING INFLAMMABLE GAS:**

The Contractor has to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders / inflammable liquids / paints etc, as required under the laws and/or as advised by the security officer of the Employers.

10.9 **TEMPORARY COMBUSTIBLE STRUCTURES:**

Temporary combustible structures will not be built near or around work site.

10.10 **PRECAUTIONS AGAINST FIRE:**

The Contractor will have to provide adequate Fire Extinguishers / Fire Buckets and drums at work site as recommended by Client/client/consultants representative. They will have to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders/inflammable liquid/paints etc. as advised by CLIENT/CLIENT/CONSULTANTS. Temporary combustible structures will not be built near or around the work site.

10.11 **EXPLOSIVES:**

Explosives shall not be stored or used on the works or on the site by the Contractor without the permission of the Client/client/consultants representative in writing and then only in the manner and to the extent to which such permission is give. When explosives are required for the works they shall be stored in a special magazine to the provided at the cost of the Contractor in accordance with the Explosive Rules. The Contractor shall obtain the necessary license for the storage and the use of explosives and all operations in which or for which responsibility of the Contractor shall indemnify the Employer against any loss or damage resulting directly or indirectly.

10.12 **PRESERVATION OF PLACE:**

The Contractor shall take requisite precautions and use his best endeavours to prevent any riotous or unlawful behaviour by or amongst his workmen and others employed on the works and for the preservation of peace and protection of the inhabitants and security of property in the neighbourhood of the work. In the event of the Employer requiring the maintenance of special police force at or in the vicinity of the site during the tenure of works, the expense thereof borne by the Employer shall be recoverable from the Contractor.

10.13 OUTBREAKS OF INFECTIOUS DISEASES:

The Contractor shall remove from his camp such labor and their families as refuse protective inoculation and vaccination when called upon to do so by the Client/consultants representative. Should cholera, plague or other infectious diseases break out the Contractors shall burn the huts, beddings, clothes and other belongings of or used by the infected parties and promptly erect new huts on the sites as required by Client/consultants representative failing which within the time specified in the Consultants's requisition, the work may be done by the Employer and the cost thereof recovered from the Contractor.

10.14 USE OF INTOXICANTS:

The sale of adent spirits or other intoxicating beverages upon the work in any of the buildings encampments or tenements owned, occupied by or within the control of the Contractor or any of his employees is forbidden and the Contractor shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition.

In addition to the above, the Contractor shall abide by the safety code provision as per CPWD safety code and Indian Standard Safety Code framed from time to time.

10.15 BREACH OF SAFETY REGULATIONS:

Breach of safety regulations will be viewed very seriously and the Contractors shall be liable for punitive action as will be recommended by the safety officer of the Employers.

11.0 REMOVAL OF IMPROPER WORK AND MATERIALS:

- 1) The client/consultant shall during the progress of the Works have power to order in writing from time to time.
 - (a) The removal from the site within such time or times as may be specified in the order of any materials which in the opinion of the client/consultant are not in accordance with the Contract.
 - (b) The substitution of proper and suitable materials and
 - (c) The removal and proper re-execution (not withstanding any previous test thereof or Interim payment thereof) of any work which in respect of materials or workmanships not in the opinion of the client/consultant in accordance with the Contract.
- 2) Default of Contractor in compliance:

In case of default on the part of the Contractor in carrying out such order the Client shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Client and shall be recoverable from him by the Client or may be deducted by the Client from any monies due or which may become due to the Contractor. Appropriate deductions may be made in the payment due to the contractor if in the opinion of the client/consultant any part of the work has not been carried out by the contractor in accordance with the contract and the specifications. Amount of such deductions will be decided by the client/consultant.

CONTENTS OF A - CIVIL WORK

SECTION	SUBJECT	PAGE NO.
1	EXCAVATING FOUNDATIONS	12
2	FILLING WITH CONTRACTORS EARTH OR MURUM	12
3	DRY RUBBLE PACKING	14
4	CEMENT CONCRETE IN FOUNDATION AND BEDDING	14
5	SAND AND MORTAR	15
6	STONE AND BRICK MASONRY WORK IN GENERAL.	15
7	BRICKS & BRICK WORK IN GENERAL.	16
8	CEMENT PLASTER.	16
9	SAND FACED CEMENT PLASTER.	17
10	SPECIFICATIONS FOR PLAIN, REINFORCED & PRESTRESSED CONCRETE	17
10-1	GENERAL	17
10-2	GRADE OF CONCRETE	19

10-3	STRENGTH REQUIREMENT OF CONCRETE	19
10-4	MATERIALS	20
10-5	PROPORTIONING CONCRETE	24
11	SPECIFICATIONS FOR THE USE OF PLASTIC COVER BLOCKS	27
12	MIXING & PLACING OF CONCRETE	28
13	REMOVAL OF CENTERING	29
14	PAINTING	30
15	CPVC PIPES	32
16	TRENCHES	38
17	LAYING AND JOINTING OF CEMENT CONCRETE PIPES	38
18	LAYING AND JOINTING OF STONEWARE PIPES	39
19	MODE OF MEASUREMENT	42
20	TESTING SAMPLES OF CEMENT CONCRETE	43
21	ADDITIONAL CONDITIONS / DIRECTIONS TO THE TENDERERS USING READY MIXED CONCRETE	44
22	APPROVED VENDOR LIST	46

S P E C I F I C A T I O N S

1. EXCAVATING FOUNDATIONS.

(a) Trenches for foundations, footings/cesspits, drains etc. to be excavated to the exact width length and depth shown or figured on the drawings or as may be directed by the Engineer. If taken out to a greater width, length, or depth than shown or required the extra work occasioned thereby shall be done at the Contractor's expense. Extra depth shall be brought up by sound masonry or concrete filling and extra length or width filled in by rammed earth or muram or, if the Engineer thinks it necessary for the stability of the work, by masonry or concrete as may be directed. The excavated material shall be used to fill in on each side of the masonry or to form the filling in of floors or it shall be placed or spread elsewhere on or near the side of the works as may be ordered free of charge. The Contractor shall at his own expense and without extra charge, make provision for all shoring, pumping, dredging, bailing out or draining water, and the trenches shall be kept free of water while the masonry or concrete is in progress and till the Engineer considers that the mortar is sufficiently set. The sides of the trenches to be kept vertical and the bottom horizontal, and to be run at the same level throughout or properly stepped as may be desired by the Engineer. The Contractor shall also, at his own cost remove such portions of boulders or rock as are required to make the bottom of the trench horizontal and level. He shall also make level and hard the bed of all the trenches and consolidate the earth about the same and against all walls, pits, drains etc. The foundation trenches to be inspected and passed by the Engineer before any masonry work is commenced and the Contractor shall hold an order in writing to this effect, other wise he shall be liable to have his work removed for inspection.

All the excavated materials belong to the MDL and therefore shall be property of MDL. It will be mandatory on the part of contractor to use this material in the execution of works under contract if the quality of material available is as per the specification. The contractor shall have to sort out the material in separate stacks and transport the same at his cost. No transportation charges or any other charges will be paid to the contractors. The rate of excavation is deemed to include the cost of transportation and disposal of surplus excavated materials to any location as directed by the Engineer in Charge. However, if the contractor is directed to dump the material to the out side of the MDL premices, tipping charges for which the contractor has to quote the rate as per tender.

(b) The measurement of the work will be the exact length and width of the lowest step of the footing according to drawings or the Engineer's instructions and the depth measured vertically. The contractor shall make every effort to carry out the excavation in rock to the correct formation levels as far as practicable. However, under cut and over cut upto 8 cm. of the formation levels shall be permitted. As far as payment is concerned quantities shall be worked out with respect to formation levels only. Under cut in excess on 8 cm. shall be removed by chiseling and over cuts for above 8 cm. shall be filled in with M-15 concrete without any extra cost.

2. FILLING IN WITH CONTRACTOR'S EARTH OR MURUM.

Scope:

This part of the specifications deals with general requirements for earthwork and filling of different materials, filling in areas shown in drawings, back filling around foundations, plinths and approach ramps, conveyance and disposal of excess soil if any or stacking them properly as directed by the Engineer-in-Charge and all operations covered within the intent and purpose of these specifications.

Applicable Codes:

The provisions of the latest Indian Standards listed below in addition to those mentioned in tender document, but not restricted to, shall form part of these specifications:

- IS: 1200 : Method of measurement of building and civil engineering works
Part 1 : Earth work
- IS: 1498: Classification and identification of soil for general Engineering purposes.
- IS:2720 : Method of test for soils (All Parts)
- IS:2809 : Glossary of terms and symbols relating to soil engineering
- IS:3764 : Safety code for excavation work
- IS:4988 : Glossary of terms and classifications of earth moving Machinery (All Parts)

Filling in with Contractor's Earth or Murum.

- (a) The earth or murum, whenever required to be supplied by the Contractors for filling in the low lying ground and wells or in the embankment of the road, shall be dry, friable, and free from mud sludges, vegetable matter or rotten material of any kind, or material likely to decay and of a quality to be approved by the Engineer. All big lumps or clod shall be broken before spreading the earth or muram on the ground.
- (b) The filling in of wells and low-lying grounds shall be done in such layers as may be directed from time to time by the Engineer, and no fresh layer shall be allowed to be put on unless the previous one is properly spread, trimmed, leveled, and thoroughly consolidated by rammers or rollers, as the case may be, or as may be ordered by the Engineer.
- (c) The embankment shall be raised in regular layers slightly concave in section, beginning from the bottom and gradually raised to the full height, layer by layer not exceeding 230 mm. in thickness in a loose state. Each layer shall be thoroughly consolidated by watering where necessary and rolling it with an approved steam or diesel roller before the next layer is put on. The rolling and consolidation should be done to the entire satisfaction of the Engineer and no rubble packing or metal should be laid on it until the Engineer is satisfied that the earthwork has been thoroughly consolidated and written certificate is given to them effect by the Engineer.
- (d) The rates for embankment or filling in with Contractors earth or murum

shall include the cost of materials, fencing, lighting, watching haulage, spreading, levelling, watering, rolling and consolidating.

Compaction on Earth or Murum:

1. Compaction is carried out using rolling. For ordinary consolidation of soft stone, 6 to 8 tonnes roller is good.
2. Rolling should commence at the edges and progress towards the centre except in super elevated portions where it should proceed from the inner edge to outer. Each pass of the roller should uniformly overlap not less than one third of the track made in the preceding pass. The number of passes required of a roller to give good compaction of any material should also be determined by actual test at site.
3. The types of roller that can be used are pneumatic tyred, vibratory rollers etc and should be operated at the minimum speed while consolidating base and soling courses.
4. For clayey soils, sands the weight of rollers that can be used are 6 to 8 Tonnes, 230 mm will be the maximum thickness of loose material that can be compacted while 10 to 18% moisture content has to be maintained.

Tests on Earth or Murum:

1. The density / moisture content of a soil needs to be determined using various tests.
2. The water content of the soil is determined by methods like oven drying, Pycnometer, sand bath methods etc.

Range of Optimum Water Content

Sand	Sandy Silt or silty sand	Silt	Clay
6 to 10 %	8 to 12 %	12 to 16 %	14 to 20 %

3. There are main field methods used for measuring compaction such as Core cutter method, Sand replacement method etc.
4. Proctor Density test is made to determine the moisture content at which the soil should be compacted to obtain the maximum dry density and the dry density likely to be achieved by compaction in the field. The dry unit weight achieved in the field using field tests are is compared with the maximum dry unit weight obtained in the standard proctor test. The dry unit weight of the order of 95 % of the maximum dry unit weight of the standard proctor test needs to be achieved.
5. The methods of tests carried out for soils shall be strictly as per the IS 2720.

3. DRY RUBBLE PACKING.

The dry rubble packing shall consist of a layer of uniform thickness of blue trap stone rubble, or any other approved stone carefully set as close as possible on

ground properly formed for the purpose. The width of the upper part of the stone shall not be more than 200 mm. or less than 150 mm. and the packing shall consist of large stones. The interstices between the rubble stones shall be filled up with stone chips, removing the projection of the upper part of the packing with care, as not to loosen the whole, the whole should be thoroughly rammed, watered, settled to place and made compact.

4. CEMENT CONCRETE IN FOUNDATION AND BEDDING.

- (a) Cement concrete in foundation and bedding shall be mixed in the proportion of M-15 as directed using Portland cement, sand and metal. In case of ordinary / nominal grade concrete, mix is required to be arrived at by preliminary tests, proportions of cement, fine aggregates and coarse aggregates are specified by mass as given in Table - 2
In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/mm².
- (b) The ground to be thoroughly leveled and well rammed before laying the concrete on the work. The concrete shall consist as described above. In case of hand mixing the metal, sand and cement, etc. as the case may be to be stacked, before mixing, in measured layers. The materials to be then thoroughly mixed in small quantities at a time with sufficient quantity of fresh water and laid in the work in layers, each not exceeding 300 mm. in depth and repeated one above the other. Salt or brackish water will not be allowed to be used. Each layer to be well rammed with heavy wooden or iron rammers. The work to be ground with thin mortar, while ramming, until it fills in all the spaces between stones and cream to the surface. The ramming operation to be continued until the whole work becomes solid and compact to the entire satisfaction of the Engineer. The measurement of the work will be the exact length, breadth and depth ordered by the Engineer or shown or figured on the drawing and after the concrete is consolidated.
- (c) The stone metal to be made of good hard blue rubble stone from quarried to be approved of by the Engineer. The metal to be such as to pass through a ring 40 mm. diameter. Larger size metal or chips will not be accepted.
- (d) The contractor shall adopt every precaution towards guarding the concrete from admixture with dust or dirt of any kind and shall use properly constructed and impervious brick masonry or wooden platform for mixing and keeping it until laid in the work and protect it from rain and sun.

5. SAND AND MORTAR.

The cement mortar shall be mixed in the proportion as described in the BOQ items.

6. STONE AND BRICK MASONRY WORK IN GENERAL.

(a) The work to be built plumb, curved, or batters, as may be required by the design and to be carried out in a thoroughly workman like manner and to the entire satisfaction of the Engineer. The Contractor to provide at his own expense all moulds, templates, centering, scaffolding etc. as may be required for the proper execution of the work which shall be included in the prices of the work, as no separate change to be made for them.

(b) All stones or bricks to be thoroughly cleaned and wetted with fresh water before being put into the work and the mortar to be used stiff.

(c) The work to be kept wet while in progress to the entire satisfaction of the Engineer till the mortar is properly set. On Sundays and other holidays also when the work is stopped, the top of all unfinished masonry to be kept flooded and labourers to be employed for this purpose. Watering to be done carefully so as not to wash the mortar out of the joints. The Engineer shall be at liberty to employ labourers to water the work should the contractors fail to do the same to his (the Engineer's) satisfaction.

(d) Should the mortar perish that is becomes dry, white or powdery through neglect of watering, the work shall be pulled down and rebuilt at the contractor's expense.

(e) As a rule the whole of the masonry work in any structure to be carried up at one uniform level throughout but where breaks are unavoidable the joint to be made in good long steps, so as to prevent cracks arising between the new and old work. All junctions of walls to be formed at the time the walls are being built, and cross walls to be carefully bonded into the main walls.

(f) When new work is to be added to existing structure, the old work must be prepared to receive the new and both must be carefully bonded together.

(g) During the rains, the work to be carefully covered without extra charge, so as to avoid the fresh mortar being washed away.

(h) Where the word cement is used it is to be understood Portland cement of the best description, specified under the head of the Cement.

7. BRICKS & BRICK WORK IN GENERAL.

(a) Bricks shall conform to the latest Indian standard specifications (I.S.S.). Bricks to be whole, sound, well burnt free from cracks to ring when struck and not to crack or break when soaked in water regular in shape and uniform in size. They should be of the best of description obtainable in the market and of the best quality and colour, and in every respect to be approved by the Engineer unless otherwise specified they should be of English pattern 230mm. x 115 mm. x 63.5 mm. No bricks to absorb water more than one fifth of their own weight when dry for use in load bearing wall. For bricks used in panel walls, the water absorption shall not exceed $\frac{1}{4}$ of their dry weight. Bricks to be thoroughly cleaned, well wetted or soaked in fresh water before being used on the work and no broken bricks to be used except as closures. Crushing strength of the dry bricks shall be not less than 35 kg./cm.²

(b) The mortar should be as described under the head of good quality carefully mixed and used stiff. For joints of face work only Cement and screened sand should be used in specified proportion.

(c) A good bond should be preserved throughout the work both laterally and transversely. All bed joints should be perpendicular to the pressure upon them, i.e. horizontal in vertical walls, radial in arches and at right angles to the slope in battering walls.

(d) In walling the courses shall be kept perfectly horizontal and rise in plumb. The vertical joints shall break joints with the courses immediately below and above, but they shall be directly over one another in alternate courses to prevent the necessity of bats. The joints shall not exceed 10 mm. thick shall be fully of mortar close, well flushed up and neatly struck or pointed as may be required.

(e) English bond to be used throughout in walling. In arching such bond shall be used as directed by Engineer.

(f) Facing of brick work to be specially selected brick of the same colour throughout. All external brick walls of thickness 25 mm. and above, shall be constructed in plumb from the outside face with the help of scaffolding erected on the external side.

(g) In other respects, the work should comply with the general specification for brick work as per relevant IS code.

8. CEMENT PLASTER.

All joints in brick masonry work shall be raked out to a depth of atleast 10mm and all RCC and concrete surfaces shall be thoroughly roughened to the entire satisfaction of the Consultant and they are to be plastered shall be washed and wetted thoroughly before plastering is commenced. Render with a mortar of specified parts of Portland cement and fine sand of specified thickness and rough but do not beat. Float or set with a thin coat 3 mm of Portland Cement and polished well immediately with a trowel or flat board. The cement mortar to be used within 30 minutes after it

leaves the mixing board or mill. Before work is started patches of plaster 150 x 150 mm. should be put on about 3 meters apart as gauges. By this means an even thickness is ensured. Cement plaster must be in even squares or stripe. Care shall be taken to keep the whole surface thoroughly wetted for at least a week. The finishing surface should be as specified and directed.

9. SAND FACED CEMENT PLASTER.

All joints in brick masonry work shall be raked out to a depth of atleast 10mm and all RCC and concrete surfaces shall be thoroughly roughened to the entire satisfaction of the Consultant and they are to be plastered shall be washed and wetted thoroughly before plastering is commenced.

Sand faced plaster; shall be carried out in two coats as specified. Two coats and sand faced plaster shall be applied as follows: The first coat of cement mortar in the proportion as specified in item shall be applied uniformly all over the surface to be plastered to a thickness of 14 mm. with a trowel and flat board in exact plumb. This coat shall be allowed to rest for not less than half an hour. Indentations shall then be made in the form of waves by a wire broom over the surface to form a key for the second coat. The plastered surface shall be allowed to cure for at least four days. First coat will be with addition of water proofing compound in proportion as specified in item.

The second coat of cement mortar shall be applied in the proportion of as specified in item using clean and screened through a mesh of not less than 1.5 mm. and not more than or 3 mm. equal size to a uniform thickness of 6.5 mm by trowel and flat board in exact plumb.

The surface shall be trapped with a cork piece to give a desirable uniform granular appearance.

Care shall be taken to keep the whole surface thoroughly wetted for at least a week.

10. SPECIFICATIONS FOR PLAIN, REINFORCED AND PRESTRESSED CONCRETE:

10-1. GENERAL

These specifications cover the requirements of plain, reinforced and prestressed concrete for use in various components of structures.

For all items of concrete in any portion of the structure or its associated works controlled concrete shall be used unless otherwise specified. Normal / ordinary concrete mix as shown on the drawing or as directed by the Engineer-in-charge, may be used.

The provisions of the latest revisions of the following I.S Codes shall form a part of this specification to the extent they are relevant.

IS-226	Specification for structural steel (standard quality).
IS-269	Specification for ordinary and low heat portland cement
IS-280	Specification for mild steel wire for general engineering purpose.
IS-303	Plywood for general purposes.
IS-383	Specification for coarse and fine aggregate.
IS-432(All Parts)	Specifications for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement. Part-I – Mild steel and medium tensile bars. Part-II – Hard drawn steel wire.
IS-455	Specification for portland blast furnace slag cement.
IS-456	Code of practice for plain and reinforced concrete (IS:456-2000)
IS-460	Specification for test sieves.
IS-516	Methods of test for strength of concrete.
IS-650	Standard sand for testing of cement.
IS-1139	Hot rolled mild steel, medium tensile steel and HYSD bars for concrete reinforcement.
IS-1199	Sampling and analysis of concrete.
IS-1200	Method of measurement of building works.
IS-1343	Code of practice for prestressed concrete.
IS-1489	Specification for portland pozzo-lana cement.
IS-1542	Sand for plaster.
IS-1566	Specification for hard-drawn steel wire fabric
IS-1732	Dimensions for round & square steel bars for structural & general engineering purposes.
IS-1785	Plain hard drawn steel wire for prestressed concrete (Part-I) Cold drawn stress-relieved wire.
IS-1786	Specification for high strength deformed steel bars & wires for concrete reinforcement.
IS-1791	Batch type concrete mixers.
IS-2062	Specification for structural steel (fusion welding quality)

IS-2386(All Parts)	Method of test for aggregates for concrete.
IS-2502	Code of practice for bending and fixing of bars for concrete reinforcement
IS-2505	Immersion type concrete vibrators.
IS-2506	Screed board concrete vibrators.
IS-2722	Specification for portable swing weigh batcher (single and double bucket type).
IS-2751	Code of practice for welding of M.S. bars.
IS-2911	Code of practice for design and construction of pile foundation (Part-I & IV).
IS-3366	Pan vibrators
IS-3370(All Parts)	Code of practice for concrete structure for the storage of liquids.
IS-3558	Code of practice for the use of immersion vibrators for consolidating concrete.
IS-4656	Form vibrators for concrete.
IS-5525	Recommendation for detailing of reinforcement in reinforced concrete works.
IS-5640	Method of test for determining aggregate impact value of soft, coarse aggregate.
IS-5816	Method of test for splitting tensile strength of concrete cylinder.
IS-6006	Uncoated stress relieved strand for pressurised concrete.
IS-6461	Cement concrete: glossary of terms.
IS-8041	Specifications for rapid hardening portland cement.
IS-8043	Specifications for hydrophobic portland cement.
IS-8112	Specifications for high strength ordinary portland cement.
IS-9103	Admixtures for concrete.

1.1 OTHER CODES AND SPECIFICATIONS

Other IS codes pertaining to the items of cement concrete work in structural work not listed above shall also be deemed to come under the purview of this clause. All Indian Roads Congress Standards, specifications and codes of practice also come under this purview.

10-2 GRADE OF CONCRETE

2.1 CONTROLLED CONCRETE

For controlled concrete, design of the mix shall be carried out for the respective target strength and in its production all necessary precautions shall be taken to ensure that the required works cube strength is attained and maintained.

The controlled concrete grades are designated as M 20, M 25, M 30, M 35, M 40, M 45 and M 50 and as per the technology used for such designation in IRC codes of practice.

2.2 ORDINARY CONCRETE (Concrete Grades M:15 & below)

In case of ordinary / nominal grade concrete, mix is required to be arrived at by preliminary tests, proportions of cement, fine aggregates and coarse aggregates are specified by mass as given in Table - 2

In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/mm².

10-3 STRENGTH REQUIREMENT OF CONCRETE

Where Ordinary Portland Cement conforming to IS:269 or Portland Blast Furnace Cement conforming to IS:455 is used, the compressive strength requirements for various grades of concrete controlled as well as nominal shall be as given in Table 1. Where rapid hardening portland cement is used, the 28 days compressive strength requirements shall be met at 7 days.

For controlled concrete, the mix shall be so designed for the so called Target strength as to attain in preliminary tests a strength at least 33 per cent higher than that required on work tests, for concrete strength upto and including M-25 and 25% higher for higher strengths.

Table 1

Grade of Concrete	Compressive Works Test Strength in N/Sq. mm on 150 mm Cubes after Testing Conducted in accordance with IS : 516	
	Min. at 7 days	Min. at 28 days
M 10	7	10
M 15	10	15
M 20	13.5	20
M 25	17	25
M 30	20	30
M 35	23.5	35

Note : In all cases, the 28 days compressive strength Should be 20% than specified in Table 1 shall alone be the criterion for acceptance or rejection of the concrete.

10-4 MATERIALS :

4.1 CEMENT:

Fresh quality cement shall be procured only from approved manufacturer / supplier and shall be subject to prior approval of the Engineer-in-Charge. Following types of cement shall be used :

- i) All cement used for the work shall be ordinary portland cement or such other cement as may be permitted by the Engineer-in-charge. Portland cement shall comply with the requirements of the latest issue of IS 269. High alumina cement, rapid hardening cement and portland Slag cement etc., can be used only when permitted by the Engineer-in-charge. Such cements shall be in accordance with relevant IS Codes. Portland Pozzolana cement when permitted by the Engineer-in-charge shall conform to IS 1489 Part I but it shall not be used or RCC structural member.
- ii) Cement which has remained in bulk storage at the mill for more than 6 months or which has remained in bags at the dealers storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications.
- iii) Different types of cement shall not be mixed.

4.2 FINE AGGREGATES

Fine aggregates shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS : 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-Charge.

The sand shall be siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

4.3 COARSE AGGREGATES

Coarse aggregates shall consist of hard, strong, durable particles of crushed stone and shall be free from thin elongated soft pieces, organic or other deleterious matter. It will be from a source approved by the Engineer-in-charge. Coarse aggregate shall conform to IS: 383.

Coarse aggregate shall be washed if necessary to remove all vegetable and other perishable substances and objectionable amounts of other foreign matter, the cost of washing and screening being borne by the contractor.

Size of Coarse Aggregates

Following shall be the maximum nominal size of coarse aggregate for the different items of work if not specified in the item of works or their respective specifications :

Sr. No.	Item of Construction	Max. Nominal Size of Coarse Aggregate
(i)	RCC well steining concrete, RCC well curb & RCC piles in plum concrete	40 mm
(ii)	Well cap or pile cap, solid type piers, abutments and wing walls, and, footing of open foundation and general items of work in bridge and building construction.	20 mm
(iii)	RCC works in girders, deck slab, wearing coat, kerbs, light posts, ballast walls, approach slab etc. and piers, returns, wing walls and retaining walls.	20 mm
(iv)	RCC bearings, shells and other thin walled members and in zones of congestion.	20 mm
(v)	For any other item of construction not covered by items (i) to (iv)	As specified in the drawings or as desired by the Engineer-in-Charge in case it is not specified on the drawing.

For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is smaller.

4.4 REINFORCING STEEL (Refer Clause 302.5 of IRC:21)

Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings which may impair or reduce bond.

- a) Fe 240 - Mild steel shall conform to the latest edition of IS: 432 Part 1.
- b) Fe 415 & Fe-500 high strength deformed bars shall conform to IS: 1786, **TMT bars conforming to IS: 1786 shall only be used.**
- c) Structural steel sections and plates shall conform IS : 226 and IS : 2062.

PERMISSIBLE LIMIT FOR SOLIDS

	Tested as per	Permissible limit max.
Organic	IS : 3025 (Pt.18)	200 mg/lit.
Inorganic	IS : 3025 (Pt. 18)	3000 mg/lit.
Sulphates (as SO ₃)	IS : 3025 (Pt. 28)	400 mg./lit.

Chlorides (as C1)	IS : 3025 (Pt. 32)	2000 mg. lit. for concrete work not containing embedded steel and 500 mg./lit. for prestressed /reinforced concrete work.
Suspended matter	IS : 3025 (Pt. 7)	2000 mg./lit.

Note : The reinforcement steel to be used for the construction shall be Corrosion Resistant Steel with Grade of Fe - 500 only (for all RCC structures).

4.5 HIGH TENSILE STEEL :-

The strands to be used for prestressed concrete structures shall conform to Class-II of I.S. 6006-1983. Low relaxation steel conforming to I.S. : 14268 : 1995 is also permitted with relaxation losses given therein.

4.6 WATER

Water used mixing and curing shall be free from injurious amounts of deleterious material. pH value of water shall not be less than 6. Potable water are generally considered satisfactory for mixing and curing concrete. Water shall be got tested before use in concrete and curing. The cost for the same shall be borne by the contractor. Permissible limits for solid shall be as below :

PERMISSIBLE LIMIT FOR SOLIDS

	Tested as per	Permissible limit max.
Organic	IS:3025 (Pt.18)	200 mg/lit.
Inorganic	IS:3025 (Pt.18)	3000 mg/lit.
Sulphates (as SO ₃)	IS:3025 (Pt.28)	400 mg/lit.
Chlorides (as C1)	IS:3025 (Pt.32)	2000 mg/lit. for concrete work not containing admixtures

4.7 ADMIXTURES

No materials other than essential ingredients i.e., cement, aggregate and water, shall ordinarily be used in the manufacture of concrete or mortar. But the Engineer-in-Charge may permit the use of approved admixtures for improving the workability of the concrete, if so specified on satisfactory evidence that its use does not in any way adversely affect the properties of concrete particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. Admixture where allowed shall conform to relevant IS : 9103.

Chloride content in admixture shall be independently tested for each batch before acceptance.

4.8 MATERIALS FOR REPAIR WORK

The use of epoxy for bonding fresh concrete used for repairs will be permitted on written approval of the Engineer-in-Charge. Epoxies shall be applied in accordance with the instructions of the Manufacture. The

cost of such repair when approved by the Engineer-in-Charge shall be borne by the contractor

4.9 STORAGE OF MATERIALS

i) Cement

The contractor shall make arrangements to the satisfaction of the Engineer-in-Charge for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved water-proof bin or silo. Bagged cement shall be stored in a suitable weather tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS-269 at any time after storage, when a retest is ordered by the Engineer-in-Charge. Each consignment shall be stacked separately with the date of receipt flagged on it, not more than 12 bags being stacked in height, the bags being arranged with headers and stretchers. Normally consignments shall be used in the order of receipt at site unless otherwise directed. In the case of large concrete pours the Engineer-in-Charge will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractors' account and no extra claim will be entertained. Cement shall be protected from closure to moisture in transit, in storage at the works and until it enters the concrete mixers. The contractor shall keep accurate records of the deliveries of the cement and of its use in the work.

ii) Aggregates

Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms, each size shall be kept separate with wooden, steel, concrete, or masonry bulk heads, or shall be stored in separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer-in-Charge.

iii) Reinforcing Steel

Reinforcing steel shall not be stored directly on the ground. These shall be stored under cover and shall be protected from rusting, oil, grease and distortions as directed by the Engineer-in-Charge.

iv) High Tensile steel

The high tensile shall be stored in humidity controlled godowns and shall not be stored for long period. The procurement of H.T. steel shall be made just before actual use and shall be stacked on wooden platform.

5.1 CONTROLLED CONCRETE

Concrete mix shall be designed for 33% higher strength than the grade of concrete specified.. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that a supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be strictly controlled. The different sizes, shall be stocked in separate stock piles. Required quantity of material shall be stock-piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the design mix.

The quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS: 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.

The minimum cement and maximum water cement ratio and minimum grade of concrete is given below :-

- A)** For bridges with prestressed concrete / RCC decking or those with individual spans greater than 30 mtrs. or those that are built with innovative design / construction.

TABLE - A
Minimum cement content, maximum water-cement ratio and minimum grade of concrete for different exposures with Normal weight aggregates of 20 mm nominal maximum size.

[Ref : Table : 5 of IS-456-2000]

Sr. No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content Kg/m ³	Maximum Free Water-Cement Ratio	Min. Grade of Concrete	Minimum Cement Content Kg/m ³	Maximum Free Water-Cement Ratio	Min. Grade of Concrete
1	2	3	4	5	6	7	8
1	Mild		0.60	-		0.55	M-20
2	Moderate		0.60	M-15		0.50	M-25

3	Severe		0.50	M-20		0.45	M-30
4	Very Severe	260	0.45	M-20	340	0.45	M-35
5	Extreme	280	0.40	M-25	360	0.40	M-40

Adjustments to Minimum Cement Contents for Aggregates other than 20 mm Nominal Maximum Size [Ref : Table:6 of IS-456-2000]

Sr. No.	Nominal Maximum Aggregate Size (mm)	Adjustment to minimum Cement Content in above table (kg/m ³)
(1)	(2)	(3)
1	10	+ 40
2	20	0
3	40	-30

Limits of Chloride Content of Concrete [Ref : Table : 7 of IS-456-2000]

Sr. No.	Type or Use of Concrete	Maximum Total Acid Soluble Chloride Content expressed as kg/m ³ of Concrete
(1)	(2)	(3)
1	Concrete containing metal and steam cured at elevated temperature and prestressed concrete	0.4
2	Reinforced concrete or plain concrete containing embedded metal	0.6
3	Concrete not containing embedded metal or any material requiring protection from chloride	3.0

Condition of Exposure :

- i) **Severe - Marine Environment :** Alternate wetting and drying due to sea spray, alternate wetting and drying combined with seeping, buried in soil (having corrosive effect); members in contact with water where the velocity of flow and the bed material are likely to cause corrosion of concrete.
- ii) **Moderate - Condition other than 'severe'**
 - a) The minimum cement content is based on 20 mm size aggregates. For larger size aggregates, it may be reduced suitably by not more than 10%. Similarly for smaller size aggregates, it may be suitably increased, but not more than 10%.
 - b) The cement content shall not exceed 540 kg/cu.m. of concrete.
- iii) **Ordinary / Nominal Concrete :**

The ordinary / nominal concrete mix shall also be specified by mass. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for 'bulking' shall be made as per IS : 2386 (Part III).

Ingredients required for nominal mix concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given in Table-2.

PROPORTION OF NOMINAL MIX CONCRETE

TABLE - 2

Grade of Concrete	Total quantity of dry aggregates by mass per 50 Kg. of cement, to be taken as the sum of the individual masses of fine & coarse aggregates, (Kg.), Max.	Proportion of fine aggregate to-coarse aggregate by mass.	Qty. of water per 50 Kg. of cement Max. (Ltrs.)
M-7.5	625	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1:1 ½ and a lower limit 1.2 ½	45
M-10	480		34
M-15	330		32

Note No. 1: The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

Note No.2 : The amount of water should be kept minimum required for proper workability. The quantity given in Col. 4 is not to be exceeded.

Example

For an average grading of fine aggregate (that is Zone the proportions shall be 1:1 ½ , 1:2 and 1:3, for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

Note No.3 : A mix leaner than M 10 may be used for non-structural parts if specified on the drawing or provided in the contract. In such case grading of aggregates shall be as specified in the contract or on the drawings. Other requirements for mixing, placing and curing shall be the same as specified in this section.

iv) Quantity of Water

The quantity of water shall be just sufficient to produce a dense concrete of required workability and strength for the job. An accurate and strict control shall be kept on the quantity of mixing water.

In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips, all reinforcements. The degree of

consistency, which shall depend upon the nature of work and the methods of vibration of concrete, shall be determined by regular slump tests. The following slump shall be adopted for different types of works or as directed by the Engineer-in-charge.

Sr. No	Type of Work	Where Vibrators are Used	Where Vibrators are not Used
i)	Mass Concrete in RCC Foundations, Footings and Retaining Walls	25 mm to 40mm	80 mm
ii)	Beams, Slabs & Columns Simply Reinforced	35 mm to 40 mm	100 – 120 mm
iii)	Thin RCC Section or Section with Congested Steel	40 mm to 50 mm	125 – 150 mm

Note: With use of ordinary concrete the slump requirement specified above would not be applicable.

11 SPECIFICATIONS FOR THE USE OF PLASTIC COVER BLOCKS: -
As per I.S. 456-2000(p. 47) clauses no 26.4.2 table no. 16.

Nominal cover to meet durability requirements

Exposure	Nominal concrete cover in mm. not less than
Mild	20
Moderate	30
Severe	45
Very Severe	50
Extreme	75

Notes: -

For main reinforcements up to 12 mm. dia. bar for mild exposure the nominal cover may be reduced by 5 mm.

Unless specified otherwise, actual concrete area shall not deviate from the required nominal cover by +10 mm.

For exposure condition 'severe' & 'very severe' reduction of 5 mm. may be made where concrete grade is M-35 and above.

Cover blocks shall be as small as possible, consistent with their purpose, of type and shape acceptable to the Engineer, and designed so that they will not overturn when the concrete is placed.

Cover blocks shall either be an acceptable proprietary brand of spacer, or they shall be made of concrete with 10 mm maximum aggregate size and mix proportions to produce the same strength as the adjacent concrete.

Concrete spacer blocks shall not be used until at least 7 days old.

Proprietary plastic spacer blocks shall be capable of supporting the weight of the reinforcement and construction loads without excessive deformation and must be

well perforated to a minimum of 25% of its area.

The Contractor shall provide sufficient mild steel chairs to support in position top reinforcement in slabs, caps and rafts, vertical wall reinforcement and the like. Steel chairs should be supplied with plastic-coated feet or approved anti-rust treatment if not properly protected by concrete.

12. MIXING AND PLACING OF CONCRETE INGREDIENTS AND MEASUREMENTS OF MATERIALS

The concrete shall be comprised of water, Portland cement, sand and coarse aggregate. If required by the Consultant the Contractor shall have to add approved brand of plasticizer in required quantities to facilitate easy flow of concrete. No extras shall be paid for providing and adding plasticizer.

All sand and coarse aggregate used on the works shall be carefully and accurately measured in suitable gauge boxes and in quantities to the entire satisfaction of the Consultant and the cement to be added to the aforesaid mix shall be either by one or two full scale bags, the water being added to the dry mix in a manner in which it can be properly controlled and measured. The cement shall be measured by weight or by bags. One bag of cement weighing 50 kg. shall be considered equal to 0.034 Cu.m. (1.20 cft) in volume. Volumetric measurement of cement will not generally be permitted. If loose cement is used it shall be weighed and 40.8 kg. shall be considered as 0.0283 Cu.m (1 cft). The contractor shall provide an accurate weighing apparatus on the work for this purpose. If he wants to use volumetric batching, he would have to prove the correct weights of cement bags.

The maximum quantity of mixing water per 50 kg. bag of cement shall be 25 liters which shall include free water carried by the Aggregate, corrections being made to this quantity of water according to the wetness of aggregate, as instructed by the Consultant. The consistency of the concrete shall be tested by the standard slump for concrete and shall be between 38mm to 64mm (1.5" to 2.5") or as directed. Contractor shall have to use approved plasticizer in required quantity at his own cost to achieve necessary workability. Water Cement Ratio should be as per the design mix and it should be strictly adhered to.

The proportioning of concrete as per design mix shall be used for mixes of grade M-20 and above. For this the Contractor shall supply the different ingredients such as cement, sand, aggregate, admixtures etc. and the required slump approved by Engineer Incharge. If any of the ingredients are altered in respect of the source of production, quality or any other parameter the same will be got approved by the Engineer Incharge and fresh design mix shall be done for the proportioning of the different ingredients to the satisfaction of the Engineer Incharge and no parameters of the design mix for the concrete ingredients shall be altered from that submitted for the design of the concrete mix.

The concrete shall be mixed in an efficient power driven batch mixer. The capacity of the drum shall as far as possible be such that only whole bags of cement are used in each batch. Mixing shall continue for atleast 1.5 minutes after all the materials including water, are placed in the drum and before any part of the batch is discharged. The drum shall be revolved not less than 14 and not more than 18 revolutions per minute. The drum shall be completely emptied before receiving materials for each batch shall not exceed the mixer manufacture's rated capacity of the drum. The drum shall be thoroughly washed out when mixing operation cease for any period longer than one hour. Hand mixing of concrete, if permitted by the consultant shall be carried out in the following manner.

The specified quantity of sand shall be spread out first making a level heap about 150mm deep on a water tight platform or trough, atleast 2.7m x 3.7m in

size, with 3 sides of sufficient depth to prevent the material being shoveled off during the operation of mixing. On the top of sand the specified quantity of cement, with an addition of 10% to allow for hand mixing, shall be spread. All the dry sand and cement shall be turned over with square ended shovels atleast 3 times until the mixture is of uniform colour. Each shovel full should leave the shovel with a spreading action as well as turning. The specified quantity of coarse aggregate shall now be added and the whole mixture shall be turned over as before. The mixing shall be continued until the whole batch has reached an even consistency and the mortar is spread evenly through the batch. The mixing should not take more than 15 minutes after the addition of water. One whole bag of cement with an addition of 10% shall be used in each batch.

Ready mix concrete of specified grade and consistency namely water cement ratio, slump, cement content etc. shall be used to the extent possible particularly where the quantity of concrete required at one time is sufficiently large. The source of supplier and specifications of the concrete including the admixtures, retarders, setting time, transit time, method of placement of concrete on the job such as pumping etc., quality assurance from the supplier etc. should be got approved from the Engineer Incharge before ordering of the ready mix concrete for the job. The test cube strength specified in the drawings shall be closely monitored for ensuring the required strength of the concrete.

Mortar or concrete which has partially set before having been placed in-situ shall not be taken into use again either by itself or after mixing with additional materials or water.

All concrete shall be deposited in the forms within 15 minutes after leaving the mixer and shall be worked round the various reinforcement carefully by means of tamping and rodding as well as suitable vibrations.

As far as possible no joints shall be provided in any RCC work. However, if need arises the same shall be provided as per the instructions of Consultant, in which case the face of the construction joints shall be made rough by hacking and thoroughly cleaned and which before proceeding with further concrete work it shall be wetted and covered over with thick cement paste or "Hack-Aid-Plast" as directed by the Consultant.

Concrete after it has been placed in the forms should be allowed to set and should not be disturbed. The concrete shall be thoroughly cured by ponding or inundation or by means of hezzian cloth covered, maintain in a wet condition. Where 53 grade cement is used curing of exposed surface of concrete shall commence within 4 hrs. of its placing. In no case shall the centering to any concrete work be removed without obtaining the permission of the Consultant. Great care shall be exercised while removing the centering to avoid jarring the structure or throwing away the forms on the floor.

The stripping time of form work shall be generally followed as per relevant I.S. Specification. However, the discretion of the Consultant shall be final. The form work of all RCC and PCC work shall be as to bring out the exposed surfaces to a smooth and clean finish. Immediately after the removal of the form work the exposed surface of all such RCC work shall be thoroughly roughened by making deep and closely spaced indentations with a pointed steel tool (Basuli) to the entire satisfaction of the Consultant. The exposed surface of RCC and concrete work wherever directed shall be finished with cement and sand plaster - smooth sand faced or rough cast as directed.

13 REMOVAL OF CENTERING

In no case shall the centering of any concrete work be removed without obtaining the special permission of the engineer or his Assistant.

Proper care shall be exercised while removing the centering to avoid jarring the structure or throwing heavy form from the floor.

Generally nothing less than the following times should elapse between the filling in of the concrete and removal of the forms: -

Type of formwork	Minimum period before striking formwork
Vertical formwork to columns, beams and slabs	16-24 hrs.
Soffit formwork to slabs (Props to be re-fixed immediately after removal of formwork.)	3 days
Soffit formwork to beams (Props to be re-fixed immediately after removal of formwork.)	7 days
Props to slabs Spanning up to 4.5 m	7 days
Spanning over 4.5 m	14 days
Props to beams and arches Spanning up to 6.0 m	14 days
Spanning over 6.0 m	21 days

After removal of the centering any roughness or irregularity on the exposed surface of the work shall be made good by thin grouting of cement or a cement wash and the whole surface shall be so finished as to present an even and uniform appearance. No plastering will be permitted on the surface.

14. PAINTING

14.1 Materials

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready mixed

Paint (Exterior grade) as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed Paint, the brand of thinner

recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used.

Approved Paints, oil or varnishes shall be brought to the site of work by the contractor in their original

containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work.

The materials shall be kept in the joint custody of the contractor and the

Engineer-in-Charge. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

14.2 Commencing Work

Painting shall not be started until the Engineer-in-Charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm. Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Paint work being started.

14.3 Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

14.4 Application

14.4.1 Before pouring into smaller containers for use, the Paint shall be stirred thoroughly in its containers, when applying also, the Paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

14.4.2 The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with Paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

14.4.3 Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

14.4.4 Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is laid.

14.4.5 No left over Paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

14.4.6 No hair marks from the brush or clogging of Paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

14.4.7 In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no Paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need not be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

14.4.8 On painting steel work, special care shall be taken while painting over bolts, nuts, rivets overlaps etc.

14.4.9 The additional specifications for primer and other coats of Paints shall be as according to the detailed specifications under the respective headings.

14.5 Brushes and Containers

After work, the brushes shall be completely cleaned of Paint and linseed oil by rinsing with turpentine. A brush in which Paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that Paint does not thicken and also shall be kept safe from dust. When the Paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

14.6 PAINTING WITH ALUMINIUM PAINT

14.6.1 Aluminium Paint shall be (conforming to IS 2339) of approved brand and manufacture. The Paint comes in compact dual container with the paste and the medium separately. The two shall be mixed together to proper consistency before use.

14.6.2 Preparation of Surface

14.6.2.1 Steel Work (New Surfaces) : All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothed with sand paper. The surface shall be thoroughly cleaned of dust.

C.G.S. Sheets (New Surfaces) : Preparation of Surface

Painting New Surface : The painting of new G.S. sheets shall not usually be done till the sheets have weathered for about a year. When new sheets are to be painted before they have

weathered they shall be treated with a mordant solution prepared by mixing 38 gm of copper acetate in a litre of soft water or 13 gm hydrochloric acid in a solution of 13 gm each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 sqm. to 280 sqm of area and is applied for ensuring proper adhesion of Paint. The painting with the mordant solution will be paid for separately. Before painting on new or weathered G.S. sheets, rust patches shall be completely cleaned with coarse emery paper and brush. All grease marks shall also be removed and the surface washed and dried and rusted surface shall be touched with synthetic enamel paint of approved brand, manufacturer and shade.

Steel Work or C.G.S. sheets (Old Surfaces): Painting Old Surface: If the old Paint is firm and sound, it shall be cleaned of grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with synthetic enamel paint. If the old Paint is blistered and flaked, it shall be completely removed as described in 13.41. Such removal shall be paid for separately and painting shall be treated as on new work..

14.6.3 Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance. As aluminium paste is likely to settle in the container, care shall be taken to frequently stir the Paint during used. Also the Paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

15. CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

15.1 CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%. The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing through it. Diameter and wall thickness of CPVC pipes are as per given in Table 18.16 below.

TABLE 18.16

Sl.No.	No min al Size	Nomi nal Outsi de Diam eter	Mean Outside Diameter		Outside Diameter at any point		Wall thickness					
							Class 1, SDR 11			Class 3, SDR 17		
			Min	Max	Min	Max	Avg. Max	Min	Max	Avg. Max	Min	Max
1	2	3	4	5	6	7	8	9	10	11	12	13
i	15	15.9	15.8	16.0	15.8	16	2.2	1.7	2.2	-		
ii	20	22.2	22.1	22.3	22.0	22.4	2.5	2	2.5	-		
iii	25	28.6	28.5	28.7	28.4	28.8	3.1	2.6	3.1	-		
iv	32	34.9	34.8	35	34.7	35.1	3.7	3.2	3.7	-		
v	40	41.3	41.2	41.4	41.1	41.5	4.3	3.8	4.3	-		
vi	50	54.0	53.9	54.1	53.7	54.3	5.5	4.9	5.5	-		
vii	65	73.0	72.8	73.2	72.2	73.8	-	-	-	4.8	4.3	4.8
viii	80	88.9	88.7	89.1	88.1	89.7	-	-	-	5.9	5.2	5.9
ix	100	114. 3	114.1	114.5	113.5	115.1	-	-	-	7.5	6.7	7.5
x	150	168. 3	168.0	168.6	166.5	170.1	-	-	-	11.1	9.9	11.1

Notes

1. For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

15.2 Dimensions of Pipes

The outside diameter, outside diameter at any point and wall thickness shall be as given in Table 18.16.

15.2.1 Diameter : The outside diameter and outside diameter at any point as given in Table 18.16 shall be measured according to the method given in IS 12235 (part 1).

15.2.2 Diameter at any point : The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

- (a) 0.5 mm, and
- (b) 0.012 dn rounded off to the next higher 0.1 mm.

15.2.3 Wall Thickness : The wall thickness of the pipes shall be as given in Table 18.16. Wall

thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the

conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the

wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point

along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the

pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges

shall be used at any four points along the length of the pipe.

Tolerance on Wall Thickness

(a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the

minimum wall thickness (e_{Min}) and the wall thickness at any point (e), ($e - e_{Min}$) shall be positive in

the form of $+y$, where $y=0.1 e_{Min}+0.2$ mm.

(b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall

thickness shall again be positive in the form of $+y$, where y would be applied in two parts.

(c) The average wall thickness shall be determined by taking at least six measurements of wall

thickness round the pipe and including both the absolute minimum and absolute maximum

measured values. The tolerance applied to this average wall thickness from these measurementsshall be within the range $0.1 e_{Min}+0.2$ mm (see Table 18.16).

(d) The maximum wall thickness at any point shall be within the range $0.15e_{Min}$ (see Table 18.16).

(e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

15.2.4 Effective Length (L_e) : If the length of a pipe is specified, the effective length shall not be less

than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be

supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

15.3 Pipe Ends

The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonablysquare to the axis of the pipe or may be chamfered at the plain end.

15.4 Physical and Chemical Characteristics

15.4.1 Visual Appearance : The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted. The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

15.4.2 Opacity : The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

15.4.3 Effect on Water : The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

15.4.4 Reversion Test : When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.

15.4.5 Vicat Softening Temperature : When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.

15.4.6 Density : When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m³ and 1650kg/m³.

15.5 Mechanical Properties

15.5.1 Hydrostatic Characteristics : When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 18.17. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

TABLE 18.17
Requirements of Pipes for Internal Hydrostatic Pressure Test

(Clause 15.5.1)

Sl.No	Test	Test Temperature Min.	Test Period	Hydrostatic (Hoop) Stress
		°C		h
1	2	3	4	5
i	Acceptance	20	1	43.0
ii	Type	95	165	5.6
iii	Type	95	1000	4.6
iv	Type	95	8760	3.6(Test for thermal stability)

15.5.2 Thermal Stability by Hydrostatic Pressure Testing : When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given in Table 18.17, Sl. No. (iv), the pipe shall not burst or leak during the prescribed test duration.

15.5.3 Resistance to External Blow at 0°C : When tested by the method prescribed in IS 4985, with classified striker mass and drop height as given in Table 18.18, the pipe shall have a true impact rate of not more than 10 per cent.

TABLE 18.18
Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test

(Clause 15.5.3)

Sl.No	Nominal pipe size	Mass of falling weight	Falling height
	mm	Kg	mm
1	2	3	4
i	15	0.5±0.5%	300±10
ii	20	0.5±0.5%	400±10
iii	25	0.5±0.5%	500±10
Iv	32	0.5±0.5%	600±10
V	40	0.5±0.5%	800±10
Vi	50	0.5±0.5%	1000±10
Vii	65	0.8±0.5%	1000±10
Viii	80	0.8±0.5%	1200±10

Ix	100	1.0±0.5%	1600±10
X	150	1.0±0.5%	2000±10

15.5.4 Flattening Test : When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.

15.5.5 Tensile Strength : When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at $27 \pm 2^\circ\text{C}$.

15.6 Sampling and Criteria for Conformity

The sampling procedure and criteria for conformity shall be as given in Annexure F.

15.7. Marking

15.7.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

- (a) Manufacturer’s name or trade-mark
- (b) Outside diameter,
- (c) Class of pipe and pressure rating, and
- (d) Bath or lot number

15.7.2 BIS Certification Marking : Each pipe may also be marked with the Standard Mark.

15.8 Fittings

The fittings shall be as follows:

- (a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
- (b) Brass threaded fittings.
- (c) Valve from size 15 mm to 160 mm
- (d) *Brass Threaded Fittings:* All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information:

- (1) Manufacturer’s name/trade mark.
- (2) Size of fitting

15.9 Piping Installation Support and Spacing

15.9.1 Concealed Piping: Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly. **DO NOT USE NAILS FOR HOLDING OF PIPES IN THE CHASES.**

15.9.2 External Installations: For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement. All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

Recommended Support Spacing (Distance between Pipe Clamps Horizontal Support)

Pipe size	Horizontal support (In Meter)			
	Temperature			
	23°C	38°C	60°C	82°C
16 mm (1/2")	1.22	1.22	1.07	0.92
20 mm (3/4")	1.53	1.37	1.22	0.92
25 mm (1/0")	1.68	1.3	1.37	0.92
32 mm (1 1/4")	1.83	1.68	1.53	1.22
40 mm (1 1/2")	1.98	1.83	1.68	1.22
50 mm (2")	2.29	2.14	1.98	1.22

15.9.3 Expansion LOOP: CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 400C temperature change.

Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

Nominal Pipe	Length of Run (Meter), Loop length in cms. Size				
	6 metre	12 metre	18 metre	24 metre	30 metre
15	43	56	69	79	86
20	48	66	81	91	104
25	53	74	91	104	117
32	58	81	102	117	130
40	63	89	109	127	142
50	71	102	124	145	63

15.10 Testing

All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

15.11 Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include CPVC pipe and fittings including plain and Brass threaded fittings and jointing solvent cement.

16 Trenches

16.1 The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

16.2 Cover shall be measured from top of pipe to the surface of the ground.

16.3 The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.

16.4 If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe. Where excavation requires blasting operation, it shall be ensured that no pipes have been stacked in the vicinity and completed pipe line in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipes in the vicinity by falling stones as a result of blasting.

16.5 After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

16.6 Roots of trees within a distance of about 0.5 metre from the side of the pipe line shall be removed or killed.

16.7 The excavated materials shall not be placed within 1 metre or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling they may be re-laid and compacted in the same order to the satisfaction of the Engineer-in-Charge.

16.8 The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.

16.9 Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water mains cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the Engineer-in-Charge

17 Laying and Jointing Cement Concrete Pipes and Specials

(i) **Trenches:** Trenches shall be as described in 16. Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope.

(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. the pipe shall be encased all-around in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(v) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(vii) The method of bedding and laying the pipes under different conditions are illustrated separately.

(viii) When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

18. Laying and Jointing Stone Ware Pipes : For all sewers and drains, glazed stoneware pipes

shall be used as far as possible in preference to other types of pipes. These are suitable, particularly where acid effluents or acid sub-soil conditions are likely to be encountered.

(i) *Trenches*: Specifications described in 17 shall apply, as far as possible. The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under a roadway, a minimum cover of 90 cm is recommended for adoption, but it may be modified to suit local conditions. The trench shall be excavated only so far in advance of pipe laying as specified by the Engineer-in-Charge. The trench shall be so shored and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains. The excavation shall be carried out with manual labour or with suitable mechanical equipment as approved by the Engineer-in-Charge. Unless otherwise specified by the Engineer-in-Charge, the width at bottom of trenches for different diameters of pipes laid at different depths shall be as given below:—

- (a) For all diameters, up to an average depth of 120 cm, width of trench in cm = diameter of pipe + 30 cm.
 - (b) For all diameters for depths above 120 cm, width of trench in cm = diameter of pipe + 40 cm.
 - (c) Notwithstanding (a) and (b) the total width of trench shall not be less than 75 cm for depths exceeding 90 cm.
- The width of trench in the upper reaches shall be increased as described in sub-head 'Earthwork'.

(ii) *Laying* : Where the pipes are laid on soft soil with maximum water table lying at invert level of the pipe, the pipes shall be bedded in cement concrete with thickness and mix as specified, projecting on each side of the pipe to the specified width of the trench . The pipes with their crown level at 1.20 m depth and less from ground shall be covered with 15 cm thick. Concrete above the crown of the pipe and sloped off to meet the outer edges of the concrete, to give a minimum thickness of 15 cm all-around the pipe. Pipes laid at a depth greater than 1.20 m at crown and maximum water table level rising above the invert level of pipe, shall be concreted at the sides up to the level of the centre of the pipe and sloped off from the edges to meet the pipe tangentially .

The pipe shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. The pipes shall be laid with socket

ends facing upstream. The body of the pipe shall for its entire length rest on an even bed of concrete and places shall be excavated in the concrete to receive the socket of the pipe.

Where pipes are not bedded on concrete, the trench floor shall be left slightly high and carefully

bottomed up as pipe laying proceeds, so that the pipe barrels rest on firm and undisturbed ground. If the excavation has been carried too low, the desired levels shall be made up with concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) for which no extra payment shall be made.

If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to

smooth surface the pipe shall be laid on a levelling course of concrete as desired.

When S.W. pipes are used for storm water drainage, no concreting will normally be necessary. The

cement mortar for jointing will be 1:3 (1 cement: 3 fine sand). Testing of joints will also not be done

(iii) *Jointing* : Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round

the spigot of each pipe and the spigot shall then be slipped home well into the socket of the pipe

previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket

caulked tightly home so as to fill not more than 1/4th of the total depth of the socket.

The remainder of the socket shall be filled with stiff mixture of cement mortar in the proportion of

1:1 (1 cement: 1 fine sand). When the socket is filled, a fillet shall be formed round the joint with

a trowel forming an angle of 45 degree with the barrel of the pipe.

After a day's work any extraneous material shall be removed from the inside of the pipe. The

newly made joints shall be cured for at least seven days.

(iv) *Testing of Joints* : Stoneware pipes used for sewers shall be subjected to a test pressure of 2.5

m head of water at the highest point of the section under test. Before commencing test, the

pipeline shall be filled with water and maintained full for 24 hours under head of 0.6 m of water.

The test shall be carried out by suitably plugging the lower end of the drain and the ends of the

connection if any and filling the system with water. A knuckle bend shall be temporarily jointed in

at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test

head, or the top may be plugged with a connection to a hose ending in a funnel which could be

raised or lowered till the required head is obtained and fixed suitable for observation. The

tolerance of two liters per centimeter of diameter per kilometer may be allowed during a period of

10 minutes.

If any leakage is visible, the defective part of the work shall be cut out and made good. A slight

amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.
Any joint found leaking or sweating, shall be rectified or embedded into 15 cm layer of cement concrete (1:2:4) 30 cm in length and the section retested.

(v) *Refilling* : In cases where pipes are not bedded on concrete special care shall be taken in refilling trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe, and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping should be done within 15 cm of the top of pipe.

(vi) *Measurements* : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

(vii) *Rate* : The rate shall include the cost of materials and labour involved in all the operations described above excluding the cost of concrete which shall be paid for separately.

19. MODE OF MEASUREMENTS:

Where not otherwise specified, the value of work done under this contract shall be calculated as follows:-

The net dimensions only filling in foundations plinth and other stone masonry or brick walls.

Brick, concrete and arching will be measured in the center of the arching, the full breadth and the full thickness of the stone, concrete or bricks in the wall.

In case of plain, curved, moulded or chamfered cut stone work the dimensions of the smallest stone out of which the work can be cut will be taken.

In woodwork the cube measurements are to be taken only on the fullest visible dimensions of the pieces of the woodwork. The cover lap of scarfs, projections of tennons etc. will not be allowed, except in the case of girders and joists, which will be measured full.

The superficial measurements of planking will be of the surface seen, and the dimensions of tongues or laps will not be allowed.

Coursed khandkee facing will be paid extra on the walling and deduction will be made for all out-stone work in the facing paid for separately.

For round columns, measurements of the square stone from which it can be cut will be taken.

Where frames are included in the items, doors and windows will be measured outside to outside (clear) of the frames after the door or window is closed. Where frames are not included, shutters will be measured clear between the frames after they are closed and rebates will not be paid for separately. Curved heads, fanlights etc. will be similarly measured. Horns will not be paid for separately.

For walling, the actual cubical content of the masonry will be taken after deducting all openings cut stone work and all other items of works paid for separately.

For cut stone steps, the measurements of only the exposed rise, tread and length of the steps will be taken; overlaps and tails will not be allowed.

Measurements of the plaster will be the whole plastered surface of the wall, after making deductions for openings and for dressings and other portions not plastered. All mouldings which will be required to be worked out true to a template and drawn near clean and level, and all exposed angles and junctions with door frames etc., to be included in the rate for plastering.

Tiling roofs with Mangalore or other similar tiles, The measurements of this work will be taken on the slopes of the roof. Nothing extra will be allowed for ridges, hips, overlaps etc.

Where lead sheet work in gutters, covering to roofs etc. is to be measured superficially, net measurements will be taken. Nothing extra will be allowed for overlaps.

Measurements for lightening conductors will be taken from the highest point of the conductor to the bottom of the earth-plats.

Asphalt flooring will be measured on the actual area covered by the asphalt.

Minton-tiled flooring will be measured on the actual area covered by the tiles.

Porbunder stone and other pavement will be measured on the actual area covered by the slabs.

When rock excavation is measured in depots, 40 percent of the measured quantity will be deducted to allow for voids.

While measuring quantities of surplus earth to be removed from site of work, 30 per cent of material loaded will be deducted from lorry measurements.

19.1 R.C.C. WORK:

All R.C.C. work will be measured and paid for at the overall design dimensions, increase in dimensions caused by the plaster finish will not be taken into account.

In the case of junctions of two or more members of R.C.C. work, only one of the members will be measured full and no claim for overlap of other members will be allowed either in respect of cubic contents or extension of reinforcement necessary at the junctions.

Junctions of the Tee and or rectangular beams with slab: - beams will be measured upto the top of the slab.

Junction of beams and columns: - columns will be measured full.

Junction of columns and footing: - footings will be measured full.

Junction of columns and pile caps: - pile caps will be measured full.

Junction of pile caps and plinth beams: - pile caps will be measured full.

Junction of gallery slabs with parapet and drop (apron walls) slabs will be measured full. Chajjas will be measured in sq. mts. arrived at by multiplying length and projection as measured on the top surface exclusive of the vertical edge. Drip moulding watas or any other mouldings will not be separately

measured.

Junction of columns and lintels: - columns will be measured full.

19.2 MODE OF MEASUREMENT AND RATES FOR M.S. REINFORCEMENT:

The rate shall be on weight basis for 1 Tonne of Mild Steel reinforcement. The weight of steel reinforcement incorporated in the concrete will be measured in Tonnes based on the total computed weights for the sizes and lengths of bars as shown on the plans or as ordered by the Engineer. No allowance will be made for wastage while computing the weight, hooks and bands will be taken into account but not the laps. The lengths of the bars shall be measured correct to two places of decimals in meters and the weight payable would be worked out on the following basis correct to 0.10 of a kg.

Diameter of bars in millimeters	Weight in Kg. per metre.
8	0.395
10	0.62
12	0.89
16	1.58
20	2.46
22	2.99
25	3.86
28	4.84
32	6.32
36	8.00
40	9.88

The wire for tying and devices for supporting bars and maintaining various clearances will not be measured or paid.

No payment will be made for pins, clips, binding wires, tack welding done in lieu of tying, separators, wire chassis and other materials used for fastening and supporting reinforcement in place. If the bars are substituted at the contractor's request and as a result more steel is used than specified only the quantity specified shall be paid. The F.M.B. rate shall include the cost of steel and of cutting, bending and binding, placing, cleaning, supporting etc., the M.S. bars including laps and wastage.

20. TESTING SAMPLES OF CEMENT CONCRETE.

20.1 PRELIMINARY TESTS FOR CONTROLLED CONCRETE

For controlled concrete preliminary tests referred to in Para 2.1 & 3.0 shall consist of three sets of separate tests, and in each set, tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimens in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests of 7 days are intended only to indicate the strength likely to be attained at 28 days.

20.2 WORK STRENGTH TESTS FOR CONTROLLED AND NORMAL CONCRETE :

Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge, when procedure of tests given above reveals a poor quality of concrete and in other special cases.

All work shall be carried out under the supervision of a qualified and a competent Engineer who will supervise proportioning, placing and compacting of concrete at all stages.

All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing, etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

20.3 STANDARD OF ACCEPTANCE

The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of specified strength.

20.4 MANUFACTURER'S CERTIFICATION: TESTING RESULTS ETC.

For all materials required for concrete construction including cement, aggregate, water, reinforcing and prestressing steel the original copies of test certificates, test results etc. either carried out by the manufacturer or any other agency, the mix design recommendations etc. shall be submitted to the Engineer-in-charge for his approval and record. It shall remain the property of the Engineer-in-charge.

20.5 CHLORIDE / SULPHATE CONTENTS

Since the chloride contents of the constituent materials of the concrete would be additive, it is desirable to keep a check on the overall chloride / sulphate contents of the concrete to keep it minimal. Specially, for prestressed concrete, the total chloride / sulphate contents of the concrete when manufactured according to the requirements of workability and strength shall be as given below. The cost of testing for the chloride / sulphate contents of the ingredients of concrete and of undertaking remedial measures if the chloride / sulphate contents is more than the permissible limit shall be borne by the contractor.

- a) Total water soluble sulphate (SO₂) content of the concrete mix expressed as (SO₂) shall
not exceed 4 per cent by mass of cement used in the mix.
- b) Total chloride content in concrete expressed as chloride-ion shall not exceed the
following values by mass of content used :

<u>Type</u>	<u>Per Cent</u>
PSC	0.10

R.C.C. (in severe condition of exposure)	0.20
R.C.C. (in moderate condition of exposure and PCC)	0.30

21. ADDITIONAL CONDITIONS/ DIRECTIONS TO THE TENDERERS USING READY MIXED CONCRETE.

1. All special conditions/directions for cement concrete work shall also be applicable.
2. The contractor shall procure RMC from the RMC plant approved by MDL only if the contractor does not possess his own RMC plant, approved by MDL.
3. Ready mix concrete prepared and transported will be as per IS 4926 of latest revision I.S. CODE.
4. Portland slag cement to be used shall conform to IS 455 & IS 8112 or OPC 53 grade at the specific instructions of Engineer-in-charge.
5. No dry mix shall be brought on site and water added there at.
6. Ready mix concrete will be brought to the site from RMC plant only by transit mixers (agitators)
7. Every transit mixer will carry delivery challan, mentioning the minimum following details.
Name of Manufacturer and Depot.
Serial No. of challan.
Date
Truck No.
Name of contractor to whom the RMC is being supplied.
Location of contract work.
Grade of concrete.
Specified workability.
Cement content and Grade of cement. (minimum cement required shall be distinctly marked.)
Time of loading.
Quantity of concrete.
Type of admixture.
8. When the truck arrives on site, the drum should always be speeded to about 10 to 15 rev/min, for at least 3 minutes, to make sure that the concrete is thoroughly mixed and uniform, before discharge.
9. Testing of Ready Mixed Concrete: - The sampling and testing requirements for ready mixed concrete are the same as those for site mixed concrete. As regards testing of workability following procedure be followed.
After making sure that the concrete has been uniformly mixed, take a sample from the first 0.5 cu. m. of concrete discharge, and do a slump (or compacting factor) test on the sample. If the result complies with the specified requirements, then the load should be accepted, If the results are beyond limits, a further sample should be taken from the second 0.5 cu. m. of the discharge, and if this is satisfactory, the load should be accepted, if not, the concrete load shall be rejected, as the same is not as per the

specification range. The specified slump is 75 to 100 mm while carrying out above tests; it may vary by 10 mm. as per IS 4926-latest revision.

10. Twelve cubes shall be cast at the plant as well as at the site for every day's work where the concrete is placed.
11. The admixtures used shall conform to IS-9103-latest rev or ASTM C-494 of latest rev and shall be compatible with the cement used for manufacturing concrete.
12. All taxed/duties etc. will be borne by the contractors and not by the MDL.
13. No extra payment will be made for the use of admixtures.
15. The contractors will make all arrangements & provide an uninterrupted access to R.M.C. plant for engineers to check the ready mixed concrete.
16. It will be sole right of the Engineer to allow or disallow the use of ready mixed concrete if all the conditions 1 to 15 are not complied with.

22. APPROVED VENDOR LIST

Sr. No.	DESCRIPTION	APPROVED MAKES
1	Cement	BIRLA, AMBUJA , ULTRATECH. L & T,
2	Reinforcement Steel (Fe 500 grade)	TATA, SAIL,VIZAG, RINL
3	Structural Steel	TATA ,SAIL, JINDAL
4	Ready Mix Concrete Suppliers	ACC, ULTRATECH,LAFARGE, GODREJ
5	For Repair works	Fosroc,Sunanda, BSF, Krishna conche Equivalent as approved by Engg. - In-charge.
6	Paint (All type)	Asian/Nerolac/Berger
7	FRP Manhole cover with frame	Everlast/Fibrocast
8	NP 2 Class Hume Pipe	Locally available (Vishwa/Bharat/Indi pipes/ Arihant)
9	CPVC pipes	Astral/Crilce/Supreme
10	Anchor fastener	Hilti/Fisher
11	Ladder type cable tray	Sudhir switchgears/Profab/Indiana
Note :	Brand deviation if any, needs to be tested for cement, steel and structural prior to using it for construction	

FIRE HYDRANT WORK

SECTION	SUBJECT	Page No.
1	GENERAL	3
1.1	Pipes	3
1.2	Ball Valves	5
1.3	Hydrant Valves	6
1.4	Hose Reel	6
1.5	R. R. L. Hose Reel	7
1.6	Nozzles	8

1. FIRE PROTECTION REQUIREMENTS

General:

Fire protection system is to be provided inside SSA workshop in Alcock yard, MDL. The design and installation of a fire fighting system is of utmost importance. The fire fighting installation on completion will have to be got cleared from the local fire fighting authorities (Fire Service) for its efficacy, suitability and usability by the Fire Service in the event of a fire.

The design of fire fighting system is as per the provisions in National Building Code of India (Part IV) (Amended upto date) and also considering the provisions in the Development Control Rules of local body/authority.

The operating pressure of individual hydrant shall be between 5.5 kg/cm² to 7 kg/cm² and the operating pressure of the farthest level hydrant from main pump shall be minimum 3.5 kg/cm².

1.1 Pipes

Scope:

Supplying & erecting C class (Heavy Duty) galvanized iron pipe (**Make – Jindal / TATA**), ISI mark of specified diameter with necessary G.I. fittings such as elbows, bends, tees, reducers, enlarger, plugs, etc. including electric resistance welding (ERW), fixing with clamps and all connected works such as excavation, drilling holes in wall, slabs, backfilling & making good the damages.

Material:

The galvanized iron pipes shall be of type and diameter as specified and shall comply with I.S.1239-1973 and 1969 for the specified type. The specified diameter of the pipes shall refer to the inside diameter of the bore pipes. The fittings of which the galvanizing has been damaged shall not be used. For the firefighting works, the C Class pipes and accessories shall be used.

Anti-Corrosive Protection on Under Ground Pipe (Make - IWL):

Corrosion protection tape shall be wrapped on M.S. Pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fiber and minimum 4mm thick and confirm to requirement of IS: 10221-Code of practice for coating and wrapping of underground mild steel pipe line. Before application of corrosion protection tape all foreign matter on pipe shall be removed

with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15mm. Also, length of 250mm shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated and wrapped after the pipe line is installed.

The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre-heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry. No joint shall be located in the thickness of the walls. If the pipe is required to be cut and the end threaded, the burns of the cut end shall be filled smooth and any obstruction in the bore shall be entirely eliminated. The rate includes wastage in cutting etc. When the pipe is to be fixed to walls it shall be fixed with standard bracket, clips or holder bates keeping the pipe about 12mm clear of the wall. The pipe shall be fixed to the wall horizontally and vertically and parallel to one another when more than one pipe is laid unless unavoidable. The supporting clips etc. for the pipe shall be spaced at about two meters or so as necessary. When holes are not left during construction they shall be cut into the walls or slabs, etc. to pass the pipe through or to fix clamps, etc. after fixing of the pipes, clamps etc. these shall be neatly made good.

Pressure Testing:

All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kg/cm² for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped. Pressure gauges may be capped off during pressure testing of the installation.

Method of Construction:

Galvanized iron pipes of specified diameter and type and galvanized iron fittings with ERW shall be erected on MS angle support with one coat of suitable primer and two coats of Post Office fire red enamel paint. Excavating and back filling trenches including dewatering, cutting through walls, floor etc. and making site good. Laying, jointing, and fixing the pipe with the fittings including cutting pipes, wastage and threading the ends. At all the road

crossings the pipes shall be laid lower than the crust of the road. During excavation if, any other service pipes (Water, electric, telephone, etc) come across, these shall be carefully protected and supported. Any damages done shall be made good. The pipe shall be laid on a well compacted bed in the trench. The trench after laying the pipe shall be refilled except at the joints in layers and manually rammed. Care shall be taken to see that no earth, etc. gets inside the pipes. The filling shall be kept raised by about 5cm. for subsequent settlement. Bedding and cushioning of murum, good earth, or sand shall be provided for the pipe in case of trench through rock. The trench at the joints shall be filled similarly after satisfactory testing of the pipe. Any surplus excavated stuff shall be disposed of satisfactorily without causing nuisance.

Mode of Measurement:

Measurement shall be for one metre of each type and diameter of pipe laid complete with fittings, clamps etc. as specified. The lengths shall be measured net on the straight and bends along the center line of the pipes and fittings correct up to a cm.

1.2 Ball valves (Make – Leader / L&T / Nutech)

Scope:

Supplying & installing cast steel socket weld end ball valve of size 20 mm. dia having cast steel body.

Material:

Body: Cast steel

Internal & ball - Stainless steel

Mode of Measurement:

Executed quantity shall be measured on number basis.

1.3 Hydrant Valves (Landing Valves) (Make - Newage/Minimax/Essel)

Scope:

Supplying and installing gun metal single outlet, hydrant valve Morris pattern, oblique type, conforming to IS:5290, ISI mark, with G.M. blanks cap and G.I. chain in an approved manner.

Material:

Valve Body, bonnet, stop valve, Check nut, female outlet: Gun Metal

Hand Wheel: M.S. or C.I. (Black painted)

Spring: Made of phosphor wire

Washer, Gasket: Rubber

Blank Cap: ABS plastic

Method of Construction:

The hydrant valve shall be connected with flange, gaskets, Nut bolts etc. with use of required tools.

The water discharge shall be not less than 900 lpm for single head and 1800 lpm for double head valves at 7kg/cm²

Mode of Measurement:

Executed quantity shall be measured on number basis.

1.4 Hose Reel (Make – Swastik / Dunlop)

Scope:

Supplying and installing wall mounting swinging (180 deg) Hose reel drum as per IS:884 and fitted with 20mm dia. 30 meter long armored rubber hose pipe as per IS: 444 (type III) G.M. chrome plated shut off nozzle of 6mm dia. CS ball valve on the inlet pipe with necessary M.S. Bracket for holding Hose reel drum fitted in position with wall fasteners, in an approved manner.

Material:

Hub and sides: Aluminium Alloy/Mild steel with PO red colour as per good engineering practices.

Wall Bracket: Mild steel

Nozzle with branch Pipe: GM Chrome plated

Stop Valve (Ball Valve): CS

Method of Construction:

The wall mounting swinging Hose reel drum with Gun Metal Nozzle, shall be connected on M.S. bracket with flange, gaskets, Nut bolts etc. with use of required tools and paints. The water flow rate shall be not less than 24 LPM and the range of jet shall be not less than 6 metre.

Mode of Measurement:

Executed quantity shall be measured on number basis.

1.5. R.R.L. Hose Pipe (Make – Newage)

Scope: Supplying fire fighting R.P.L. Hose pipe, conforming to IS: 636 (Type-B) 15 metre length, fitted with male and female G.M. coupling conforming to IS:993, with ISI mark.

Material:

Hose pipe material: RPL lined canvass hose of 63mm dia., the lining and the cover shall be of uniform thickness, reasonably concentric and free from air blisters, porosity and splits. The tensile strength shall be minimum 5.00 MPa and shall withstand pressure of 10.2kg/cm²

Coupling: Gun metal

Method of Construction:

Hose pipe of 15 metre length with male and female Gun metal coupling shall be connected as per direction.

Mode of Measurement:

Executed quantity shall be measured on number basis.

1.6 Nozzles (Make - Newage)

Scope:

Supplying G.M. branch pipe of 63 mm diameter with specified length fitted with 20 mm diameter detachable hexagonal nozzle confirming to IS: 903, ISI mark.

Material:

Nozzle : Chrome plated Gun metal

Method of Construction:

Gun metal hexagonal nozzle fitted with required tools and including necessary labour, material etc.

Mode of Measurement:

Executed quantity shall be measured on number basis.

1.7 Pressure Gauge

Scope:

Supplying and erecting Air release cock of 20/25mm Φ made from G.M. with necessary G.I. coupling for fixing on top of Air vessel or on wet riser.

Material:

Air release Valve: Gun metal

Coupling: G.I.

Method of Construction:

Air release Valve with necessary GI coupling shall be fixed on top of wet riser with required labour, tools etc.

Mode of Measurement:

Executed quantity shall be measured on number basis.