

INDIAN STRATEGIC PETROLEUM RESERVES LIMITED

STRATEGIC CRUDE OIL STORAGE CAVERN FACILITIES
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(TENDER NO. ISPRL/VSP/RCC ROAD LAYING TO HILL TOP /T9/16 dated 28.12.2016)



SECTION IV

TECHNICAL SPECIFICATIONS

**BIDDING DOCUMENT FOR
RCC ROAD TO GREEN BELT AT ISPRL, VISAKHAPATNAM**



C O N T E N T S

1. SPECIFICATION

SECTION	-	1	GENERAL
SECTION	-	2	DISMANTLING/DEMOLITION WORK
SECTION	-	3	EARTHWORK IN EXCAVATION FOR FOUNDATIONS, TRENCHES, BASEMENTS,DRAINS, CULVERTS ETC.
SECTION	-	4	FILLING IN PLINTH, BACKFILLING OF FOUNDATIONS & PITS
SECTION	-	5	PLAIN AND REINFORCED CEMENT CONCRETE WORK
SECTION	-	6	BRICK AND STONE MASONRY WORK
SECTION	-	7	MORTAR FOR MASONRY AND PLASTER WORK
SECTION	-	8.	PLASTER WORK
SECTION	-	9	MISCELLANEOUS WORK
SECTION	-	10	ROAD WORK



SECTION – 1 - GENERAL

1.0 GENERAL

1.1 Application of Specification

This specification shall be read in conjunction with other documents forming the Contract.

1.2 The construction work shall be carried out in such a manner that where some existing features/structures are to be integrated with the new work, work shall proceed without upsetting the existing situation. Construction shall be carried out in a co-ordinated manner with the work of other contractors in the area.

1.3 During work on and/or in the vicinity of existing rail tracks the Contractor shall take all necessary precautionary measures. Watchmen shall be engaged with red lights/flags on either side of the working place with caution board during the period of working to caution the men working regarding approaching of any rolling stock. Warning signals during day and red lamps during night shall be provided to the watchman.

1.4 Available soil Investigation report for the site shall be deemed to be studied by the Contractor prior to submission of his tender. Additional soil investigation work, if required for the purpose of the work, shall be done by the Contractor of their own.

1.5 The Contractor, before submitting his tender shall visit the site and ascertain the local conditions, labour rules, availability of construction materials, traffic restrictions, all obstructions in the area and also ascertain all site conditions including sub-soil conditions and shall allow for any extras likely to be incurred due to all such conditions in his quoted prices. No claim shall be entertained from the Contractor on any such account under any circumstances whatsoever.

1.6 Setting Out and Leveling

The Contractor shall set out and level the works and will be responsible for the accuracy of the same. He is to provide all instruments and proper qualified staff with labour for getting his work checked by the Engineer/Consultant. Such checking, if any shall not, however, relieve the Contractor in any way of his responsibility for correct setting out.

1.7 Safety

The Contractor shall take adequate precautions to ensure complete safety and prevention of accidents at site. The



safety precautions shall conform to the following IS codes wherever applicable.

IS:3696 .. Safety code for scaffolds and ladders
(Part-1& 2)

IS:3764 .. Safety Code for Excavation Work

IS:4014 .. Code of practice for steel tubular scaffolding.
(Part-1)

IS:4014 .. Safety Regulations for Scaffolding.
(Part-2)

IS:4082 .. Recommendations on stacking and
storage of construction materials at site

IS:4130 .. Safety Code for Demolition of Buildings

IS:4138 .. Safety Code for Working in Compressed Air

IS:5121 .. Safety code for piling and other deep foundations

IS:7293 .. Safety Code for Working with Construction
Machinery

The Contractor shall also abide by the safety regulations of the Employer and other directives given by the Engineer/Consultant from time to time.

1.8 Keeping Works Free from Water

The Contractor shall provide and maintain at his own cost, pumps and other equipment to keep the works free from water and continue to do so until the handing over of the Works.

1.9 Rubbish

The Contractor shall clear all trees, rubbish, vegetation, sod, brickbats etc and dispose them suitably in allotted areas at his own cost.

1.10 Bench Marks, Reference Pillars etc

The Contractor shall protect surveyor's bench marks and reference lines, ground water gauges and control points from damage or movement during work. In case of any damage, the Contractor shall have to restore them to original condition at his own cost.

1.11 Standards (Latest edition)

Unless specifically mentioned otherwise, all applicable codes and standards published by the Bureau of Indian Standards, IRC (Indian Road Congress) Codes, specification for road and



bridge works under Ministry of Road. Transport and Highways (MORTH), (4th Revision), Indian Railway Standard Specification by Ministry of Railways and all other such documents as published on the date of award of contract shall govern design, workmanship, quality and properties of materials, method of field and laboratory testing, method of measurement for different items of work and other pertinent features etc.

In case of variance between this specification and the various standards mentioned above, the provisions of this specification shall prevail upto the extent of such variance, except as mentioned in specific section.

1.12 Secrecy of Information

The Contractor shall not divulge any information that he may obtain regarding this project to any other party.

1.13 All obligations of the Contractor as specified shall be carried out by the Contractor within contract price and no additional payment will be due beyond the contract price for carrying out all such work. Wherever it is stipulated in the specification that Contractor will carry out a work at his own cost or expense or without any extra cost to the Employer or similar, it must be clearly understood that such stipulation has been made only for the sake of emphasis but such stipulation will not be construed to mean that any additional amount will be payable for carrying out any work as specified where no such stipulation has been made.

1.14 All the civil work shall be carried out as per the drawings, Bill of Quantities, specification and as directed by Engineer/Consultant.



SECTION - 2 - DISMANTLING/DEMOLITION WORK

1.1 Planning

Before starting the actual dismantling work, the Contractor shall carefully study the structures/buildings/equipment to be dismantled/demolished and of the manner in which various parts are supported and also how far the stage by stage demolition will affect the safety of the adjoining structures, if any. The Contractor shall then prepare a definite plan of the procedure for systematic demolition and submit to the Engineer/Consultant for his approval. The plan of procedure as approved by the Engineer/Consultant shall be rigidly followed in actual execution of the demolition work.

1.2 Working Condition

The dismantling operations if required to be carried out in an operating plant shall be done without any hindrance to the plant operation activities.

All dismantling work shall be carried out in a phased manner as approved by the Engineer/Consultant.

1.3 Safety

The Contractor shall take adequate precautions to ensure complete safety of all installations and the operational personnel working in the region, while carrying out the dismantling work and transportation.

All safety codes as prescribed by the Employer for working in the plant area and the safety codes prescribed by other mandatory bodies shall be followed by the Contractor while dismantling.

On all demolition works, safety signals like danger boards, red lights, safety net etc as needed and/or as directed shall be conspicuously exhibited and the area of demolition shall be kept barricaded or kept manned to prevent trespassing by unauthorised persons.

First-aid equipment shall be kept at the site of demolition work of any magnitude for emergency use.

Personal safety equipment as mentioned hereunder shall be made available for the use of persons employed on the demolition work and maintained in good condition.

- i) Safety helmets and shoes to workmen entering into dismantling site.
- ii) Goggles preferably made of celluloid lens to workmen employed on demolition of walls, floors, etc to protect the eyes from flying pieces, dirt, dust etc,



- iii) Gloves to workmen engaged on demolishing RCC work, removing steelwork etc.
- iv) Safety belts, fall arrestor to workmen working at height.

1.4 Tools and Tackles

- 1.4.1 All tools and tackles and equipment viz diamond sawing machine for cutting floor panels, chipping guns, hydraulically operated rock and concrete splitter, rock breaker, pneumatic/paving breaker, core cutter, gas cutting set, movable/crawler crane etc as required for dismantling/demolition shall be arranged by the Contractor.

1.5 Scope of Dismantling/Demolition

- 1.5.1 On being given the clearance for dismantling of building/structure/equipment, the Contractor shall take over the area for dismantling and shall shut-off all utility lines and disconnect power lines etc. The Contractor shall then check up all the closed valves of the utility lines like gas lines, oil lines, compressed air line, water line, steam line etc. All these lines shall then be provided with suitable blanking arrangements at the tapping points or at suitable points approved by the Engineer/Consultant before the dismantling work is undertaken.
- 1.5.2 Similarly, all the power cables, bus bars, control cables, instrument cables, earthing etc shall be disconnected from the supply sources at suitable locations as approved by the Engineer/Consultant.
- 1.5.3 Structural: All columns, supports, platforms, covers, railings, ladders, stairs, roofs, girders etc shall be dismantled from their erected position without any damage. In case existing structures require to be cut, the Contractor shall take prior permission of the Engineer/Consultant. All rivets and welding shall be burnt out to dismantle the structures. All bolts and nuts shall be opened out to the extent possible.
- 1.5.4 Refractory and insulation work: All the refractory and other insulation work shall be dismantled. Care shall be exercised to see that the steel shells and/or structures are not unduly damaged.

Muck arising out of dismantling of refractory shall be transported out, dumped and leveled in the dumping area allotted by the Engineer/Consultant for the purpose. Bricks which are not burnt out or which have not lost shape and size shall be separately stacked in the areas allotted by the Engineer/Consultant within a lead of 3 km inside the plant boundary.



- 1.5.5 Electrical equipment: Electrical equipment like motors, distribution board, push button station control devices, limit switches, cabling etc shall be dismantled in identifiable pieces without any damage.

All the dismantled cables, wires etc shall be made into suitable rolls, packed.

- 1.5.6 Instruments and controls: All instruments and controls including connecting cables installed shall be dismantled without damaging the same.

- 1.5.7 Utility piping and equipment: All instruments and controls including connecting cables installed shall be dismantled without damaging the same.

- 1.5.8 Demolition of civil works: All concrete and other civil construction works shall be dismantled up to a level 500 mm below the existing ground level if and where no new foundations are interfering. In case the new foundations/structure interfere then the concrete and other civil construction work will have to be dismantled fully.

- 1.5.9 Disposal: All the equipment dismantled under clauses 1.5.1 to 1.5.8 above (both inclusive) shall be transported to the disposal yard or scrap and salvage stores of VSP to the stores as directed by Engineer/Consultant.

All dismantled muck shall be transported out, dumped and leveled in the dumping place allotted by the Engineer/Consultant.

Dismantled muck shall not be allowed to be heaped up in the operating area of the plant and hence the muck shall be disposed off expeditiously.

During dismantling care shall be exercised to see that the dust arising out of dismantling is kept down by the frequent spraying of water.



SECTION-3 - EARTHWORK IN EXCAVATION FOR
FOUNDATIONS, TRENCHES, BASEMENTS,
DRAINS, CULVERTS ETC

1.1 Codes and Standards

- IS:1200 .. Method of Measurement of Building and
(28 parts) Civil Construction Works.
- IS:1498 .. Classification and Identification of Soils for
General Construction Purposes.
- IS:3764 .. Safety Code for Excavation Work

1.2 Classification of Soil

The soil shall be classified for payment according to IS:1200 and/or as per the item descriptions. All types of soil/rock excluding hard rock requiring blasting shall mean all soil and rock which can be excavated by axes, shovel or Phawara or earth moving equipment such as excavator, power shovels, paving/pneumatic breaker etc or quarried/split by crowbars without recourse to blasting and/or other quarrying methods such as chiseling, wedging, heating etc. In case any blasting is done by the Contractor in soils other than hard rock at his own convenience, such work will not be taken to be excavation in hard rock.

1.2.1 For purpose of measurement of hard rock excavation, serviceable boulders above 75 mm but not exceeding 300 mm must be stacked as directed by the Engineer/Consultant. Payment will be made on the volume of stacks less 50% for voids. Secondary blasting/breaking required, if any, to conform to the size of boulders mentioned above, is account for all excavated rock. If serviceable boulders are required by the Contractor for his works, it may be issued on the basis of stack measurement less 50% for voids at the issue rate to be specified by the Employer. If the total quantity based on stack measurements less 50% for voids exceeds the quantity calculated by sectional measurements, the payment will be restricted to sectional measurements only.

1.2.2 The excavated unserviceable materials from rock excavation that are not required to be stacked shall be disposed off in spoil dumps/fill areas. The quantity of unstacked excavated materials is to be arrived at by deducting the volume of stacked materials as computed in Clause 1.2.1 above from the total volume of the pit for hard rock excavation calculated on the basis of levels and sections.

1.3 Setting Out

The work shall be set out to exact dimensions as shown on the approved drawings and excavation shall be commenced only after prior approval of the Engineer/Consultant. Side slopes, beams or shoring/strutting etc for excavation work shall be as directed by the Engineer/Consultant. Prior approval of the Engineer/Consultant shall be obtained for a



suitable method of protection before excavation work is commenced.

1.4 Cleaning and Grubbing Up

The Contractor shall at his own cost grub up old roots, break up and remove old concrete or brick foundations, drains or manholes, empty and cleanse all old wells, cesspools and ponds found prior to/during progress of excavation, seal up water, sewerage and other connections where required, remove all contaminated earth and fill in voids with approved materials and ram well.

1.5 Stripping

The Contractor at his own cost shall strip the surface of the site prior to the commencement of excavation to remove vegetable soil and carry such soil to separate soil heaps on the allotted site within 500 m.

The Contractor shall not remove any tree without the permission of the Engineer/Consultant.

Stripping work is deemed to have been included in the rate for earthwork in excavation and no extra will be paid.

1.6 Excavation

The Contractor shall excavate by mechanical means to remove materials of any nature or description which may be encountered and excavate to depths, widths and inclinations as directed. The bed of the excavation shall be made level and firm by watering and ramming. While carrying out excavation for drain work, the sides and the bottom shall be cut to the exact shape, slope and gradient. The surface shall be properly dressed. Excavated material shall not be placed within 1.5 m from the edge of any excavation.

1.6.1 Excavation and Transportation by Mechanical means

The Contractor shall excavate the earth by mechanical excavator and transport the excavated earth by using dumpers/tipper. Levelling/grading of earth shall be done by using dozer or by any other mechanical means. Before commencement of mechanical excavation/ grading Contractor shall obtain clearance from Engineer/Consultant to ensure about underground facilities. Wherever excavation by normal excavator is difficult due to shortage of space/approach, smaller/mini excavator shall be used to avoid manual excavation. Contractor shall have sufficient numbers of wheel barrows to handle earth for small lead where disposal of earth by dumper is not suitable and difficult due to site constraint. The excavated earth required for backfilling, the minimum lead distance considered as 500 metre. The balance earth shall be disposed off within plant



boundary up to a distance of 3 km. If dumping is not possible within plant boundary, then dumping to be made outside plant boundary in salt pan area of lead approx. 10 km.

1.7 Blasting

Blasting shall be carried out according to Section-4 of this specification.

1.8 Variation in Excavation

1.8.1 Bad ground: Should the bottom of any excavation appear to be soft, unsound or unstable, the Contractor shall report the matter to the Engineer/Consultant and if the Engineer/Consultant so directs, shall excavate the same to indicated depths. In case of such extra excavations the extra depth shall be filled up with concrete or such other materials as the Engineer/Consultant shall direct, such extra excavations and fillings shall be valued and paid for as an authorised extra item.

1.8.2 Excavation too deep: If the Contractor excavates to levels lower than actual level for any unauthorised reason he shall fill it up at his own expense to the proper level with concrete or such other materials as directed. No payment will be made for such excavation taken down to depths lower than actual level and for the filling carried out as directed.

1.8.3 Slips and falls: Every precaution shall be taken against slips and falls of earth, clay, sand or other materials in the excavations, but in the event of any such occurring, the Contractor shall at his own expense make good the space affected by the slips or falls, even if the affected area may be outside the dimension of the work ordered.

The Engineer/Consultant will determine in each case whether such affected area is to be filled up in whole with concrete, brickwork or masonry of the quality used in the adjoining work or where only a part is to be so filled, the materials to be used for this part.

If in the opinion of the Engineer/Consultant there is a possibility of the newly constructed work having been damaged or disturbed by such a collapse, the work shall be laid bare at the expense of the Contractor for inspection. Any damage shall be made good by the Contractor at his expense.

1.9 Keeping Works Free from Water

The excavation for foundation and building area shall be kept free from water by the Contractor at his own expense either by bailing out water with buckets manually or by pumping. Bailing out or pumping of water shall be carried out either directly from the excavation or from sumps made outside the excavation as directed. Adequate care shall be taken to prevent movement of water through freshly laid



concrete or masonry work.

- 1.9.1 Pumping: The Contractor shall provide and operate pumps of adequate capacity or other equipment necessary to drain and keep all excavation pits, trenches etc free from water at all times during the continuance of the Contract at his own expense.
- 1.9.2 De-silting: If any excavation for foundation gets filled up with water due to rain, seepage or for any other reason, the water shall be removed and the bottom of the excavation shall be cleared of all silt/slush by the Contractor at his own expense.
- 1.9.3 Disposal of water: All water pumped or bailed out during dewatering of pits and trenches shall be disposed of to the nearest sewer or natural drains or ponds through properly laid channels or pipes by the Contractor as directed at his own cost. Disposal of water shall be carried out in such a way that no inconvenience or nuisance is caused to the work in progress in the area or to other agencies working in the area or cause damage to property and structures nearby.

1.10 Protection of Work

- 1.10.1 The Contractor shall support and maintain adjoining and abutting property and structures to render work safe to persons, property and structures/installations during the course of construction activity. The Contractor shall plank and strut as may be required on the sides of all excavation. The Contractor shall replace or repair at his own cost in an approved manner, all work damaged through removal of such temporary work or improper protective work.

The Contractor shall provide necessary decking, guard, fences, planking with red flags and red lights at night to maintain safe pedestrian and vehicular traffic near all open excavations at his own cost.

- 1.10.2 Shoring and strutting: Shoring and strutting shall be used as directed when excavation is to be carried out in soft, slushy or filled up soil which is likely to collapse during the excavation work. The shoring shall be either open or close boarded type or sand bag shoring depending on the nature of the soil and depth of excavation and the type adopted shall be as directed by the Engineer/Consultant. While excavating in a very unstable ground requiring support throughout the period of excavation, runner rail shall be used and shall be driven always in advance of the excavation. The size and spacing of different members to be used in shoring shall be as directed by the Engineer/Consultant, depending on the site conditions.
- 1.10.3 Open boarded shoring: The work shall be carried out as specified in clause 1.10.2 but the poling boards shall be placed in such a way that the spacing between the poling



boards should not exceed 500 mm and should at least cover 50% of the surface area of the excavations shored.

- 1.10.4 Runners rails: Runners rails shall be driven slightly in advance of the excavation to form a close vertical support to the sides of the excavation. The runners shall be lowered one at a time by digging away the ground below the toe and tapping the runner down after loosening the wedges. The wedges shall be tightened again after lowering the runner in position. All the runners shall be lowered in a similar manner by about 150 mm to 225 mm and excavation shall be carried out to the required depth by continuously lowering the runners as stated above always keeping the toes of the runner into the ground to prevent earth from slipping in.
- 1.10.5 Protecting railway track: All running tracks in the areas of excavations shall be protected/supported as directed in order to maintain the operation traffic. Permission from appropriate authorities shall be taken prior to commencing any work on a running rail track.



SECTION - 4 - FILLING IN PLINTH, BACKFILLING OF FOUNDATIONS & PITS

1.1 Backfilling of foundations, pits, pipe trenches and in plinth or below floors shall be carried out as specified hereinafter. Materials obtained from excavation in foundations, if suitable, shall be used as far as possible for backfilling. If sufficient suitable materials are not available on the site to complete all fillings to required grades, they shall be brought to site by the Contractor from spoil dump area or any other place as directed by Engineer/Consultant. Immediately upon the completion of each phase of work, the Contractor shall at his own expense clear the mounds or heaps of earth which may have been raised or made and remove all earth and rubbish which may have become surplus in execution of the work within a lead as directed, no payment for double handling of the spoil shall be payable.

1.2 Fill Materials

Earth used for filling shall be free from organic and other objectionable matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock/slag, the boulders shall be broken into pieces not bigger than 150 mm in size and mixed with fine materials consisting of decomposed rock, moorum, stone dust, gravel earth and the mixture shall be used for filling.

1.3 Filling around Foundations with Earth

Before commencement of backfilling, the Contractor shall remove from the space around the foundations all shoring and form work, all debris, brickbats, bits of timber, cement bags etc. Filling shall be carried out in layers not exceeding 250 mm in depth up to 1 mt depth from finished ground level or any other level as specified by Engineer/Consultant. Each layer shall be watered, rammed and compacted before the next layer is deposited. Below 1 mt of the finished ground level, mass backfilling shall be done with approved fill material.

1.4 Plinth Filling

In small buildings, plinth filling with earth shall be generally carried out in a manner as specified in Clause 1.3 and as directed by the Engineer/Consultant. Thickness of each layer of filling shall not exceed 150 mm. In large floors like factory floors, the filling materials shall be deposited in layers not exceeding 250 mm in thickness and rollers shall be used to achieve the degree of compaction as indicated in Table

1.2. When power driven roller is used, every third and the top most layer shall be compacted by the power roller and the rest by rammers. Water shall be sprinkled during the compaction to maintain the desired moisture content for maximum compaction. Special care shall be taken to compact the filling at the junction of floors with walls or columns.



1.5 Sand Filling

Sand used for filling shall be free from dust, organic and other objectionable matter and shall not contain more than 10% of clay.

Filling and compaction of sand shall be carried out as specified for earth filling in Clause 1.4. When filling has reached the approximate level, the area shall be flooded with water for a minimum period of 24 hours to allow the fill to settle. The filling shall be allowed to dry and then compacted and dressed to the required level.

1.6 Filling in Pipe Trenches

Earth filling of pipe trenches shall be carried out in layers not exceeding 250 mm in thickness, watered, rammed and compacted on the sides and top of pipes, taking necessary precaution so that the pipes are not damaged during the execution of the work.

In case of pipe trenches in rock, filling shall be carried out with earth/moorum or pulverised decomposed rock upto a depth of 250 mm above the crown of pipe and the remaining filling shall be carried out with a mixture of rock and finer materials as indicated in Clause 1.2. Filling shall be carried out in a manner as specified in Clause 1.4.

1.7 Embankments

1.7.1 The finalised formation width, side slopes and grade of the embankment shall be as per requirement.

1.7.2 The materials used in formation of the embankment shall be granulated blast furnace slag, earth, moorum, gravel, a mixture of both or any other material approved by the Engineer/Consultant. Materials used shall be free from logs, stumps, roots, rubbish or any other ingredients likely to deteriorate or affect the stability of the embankment. Generally the material used for the formation of the embankment shall satisfy the density and compaction requirements given in Table-1.1 and 1.2.



TABLE-1.1

Sl. No.	Type of Work	Maximum Laboratory Dry Density when tested as per IS:2720 (Part-VIII)
1.	Embankment upto 3 m height	Not less than 1.52 gm/cc
2.	Embankment exceeding 3 m height	Not less than 1.60 gm/cc
3.	Sub-grade	Not less than 1.75 gm/cc

TABLE-1.2

Sl. No.	Type of Work	Relative Compactness as percentage of maximum Laboratory Dry Density as per IS:2720 (Part-VIII)
1.	Embankment	Not less than 95%
2.	Sub-grade	Not less than 97%

- 1.7.3 Workmanship: The top soil existing over the embankment foundation shall be stripped to depths as required.

The ground shall then be consolidated by rolling with a 8 - 10 tonne power roller with a maximum of 6 passes to the satisfaction of the Engineer/Consultant.

Any unsuitable material occurring in the embankment foundation shall be removed and replaced by material approved by the Engineer/Consultant and compacted suitably.

The embankment material shall be spread in an uniform thickness over the entire width of the embankment in layers not exceeding 250 mm in loose thickness. When embankments are on side-long ground the whole area of the embankment on slope shall be benched out or stopped so as to prevent the material from sliding. Successive layer shall not be laid until the layer under construction has been thoroughly compacted to the requirements set hereunder.

Moisture content of the material shall be checked at the source of supply and if found less the same shall be made good by sprinkling water after spreading the soil in loose thickness for compaction. If the material delivered on embankment bed is too wet it shall be allowed to air-dry till the moisture content is acceptable by the Engineer/Consultant for compaction.

Moisture content of each layer shall be tested in accordance with IS:2720 (Part-II) and shall be so adjusted that it is 1 or 2 per cent below the optimum moisture content determined in accordance with IS:2720 (Part-VIII).



In construction of embankment over the culverts or pipe drains care shall be taken to bring the embankment up equally on both sides simultaneously and over the top of the structure.

If embankments are made from borrow pits, the Contractor shall strip the top of borrow pit to get rid of vegetations and deleterious materials and then excavate the earth from the borrow pits approved by the Engineer/Consultant. The borrow pits shall be regular in width and slope and shall be properly graded.

1.8 Control of Compaction

The Contractor shall conduct Laboratory Proctor Density Tests at regular intervals as per IS:2720 (Part VIII) and field dry density tests as per IS:2720 (Part XXVIII) or IS:2720 (Part XXIX) for each layer of 200 mm fill and for every 10,000 sq m area one (1) field density test shall be carried out as specified. For the embankment minimum one (1) field density test shall be carried out in each layer of 250 mm thickness and within every 200 m stretch of embankment to confirm that the specified degree of compaction has been achieved in the field. The cost of conducting all such laboratory and field tests shall be included by the contractor in his rates. In case the field tests indicate that the degree of compaction achieved is less than the specified values, the contractor will recompact the particular layer of fill including watering if necessary and retest the same till the specified degree of compaction is achieved at no additional cost to the Employer. All tests shall be conducted in presence of Engineer/Consultant or his representative.

1.9 Compaction

Compaction work shall be carried out by a sheep's foot roller capable of giving bearing pressure of 25 kg/sq cm of foot area in contact at a given time. The layer of earth fill shall be compacted till the feet of the sheep's foot roller commences rising out of the ground. Depending on the type of material smooth-wheeled vibratory or pneumatic rollers may be used if approved by the Engineer/Consultant. The Contractor shall demonstrate the efficiency of the rollers to obtain approval of the Engineer/Consultant. Compaction equipment viz. vibratory roller, pneumatic roller etc may be used for compaction purpose with prior approval from Engineer/Consultant.

Each layer of the material shall be thoroughly compacted to obtain a field dry density not less than 95% of the maximum laboratory dry density as per IS:2720(Part-VIII).

When density measurement reveal soft areas in the embankment, further compaction shall be done as instructed by the Engineer/Consultant. In spite of this if specified



density is not achieved then the soft area shall be removed and replaced by approved material and compacted to the specified density requirement.



SECTION - 5 - PLAIN AND REINFORCED CEMENT CONCRETE WORK

1.0 Codes and Standards

General

IS:1200 - Method of Measurement of Building and Civil
(28 Parts) Engineering Works

Cement

IS:455 - Portland Slag Cement
IS:8112 - 43 grade ordinary portland cement
IS:12269 - 53 grade ordinary portland cement

Aggregate

IS:383 - Coarse and Fine Aggregates from Natural Sources for
Concrete
IS:2430 - Method of Sampling of Aggregates for concrete
IS:2386 - Methods of Test for Aggregates for concrete
(8 parts)

Plain and Reinforced Concrete

IS:456 - Code of Practice for Plain and Reinforced Concrete
IS:460 - Test Sieves
(3 parts)
IS:516 - Method of Test for Strength of concrete
IS:1199 - Method of sampling and Analysis of concrete
IS:1607 - Method for Test Sieving
IS:1834 - Hot Applied Sealing Compounds for Joint in
Concrete
IS:3370 - Code of practice for concrete structures
(4 parts) for the storage of liquids
IS:4925 - Concrete Batching and Mixing Plant
IS:10262 - Recommended Guide Lines for Concrete Mix
Design

Steel

IS:432 - Mild Steel and Medium Tensile Steel Bars and
(2 parts) Hard-drawn Steel Wire for Concrete
Reinforcement
IS:1568 - Wire Cloth for General Purpose
IS:1786 - High Strength Deformed Steel Bars and Wires for
Concrete Reinforcement
IS:2062 - Steel for general structural purposes

fixing of Bars for

Concrete Reinforcement
IS:2751 - Welding of Mild Steel Plain and Deformed Bars for
Reinforced Construction
IS:9417 - Recommendations for Welding Cold Worked Steel



SECTION - 6 - Bars for Reinforced Concrete Construction

1.1 Work Included

The Contractor shall furnish materials, labour, plant, equipment and tools to complete the work as specified herein.

1.2 Materials

1.2.1 Cement: The cement used shall be any of the above, mentioned in clause 1.0 and the type selected shall be appropriate for the intended use. The Contractor shall carry out the required tests at his own cost in an approved testing laboratory, at the direction of the Engineer/Consultant, for all cements supplied by him and submit the test report for the approval of the Engineer/Consultant, before using the cement in the works. If there is doubt in the quality of cement, Engineer/Consultant may ask the Contractor for supplying of cement sample of testing of the same in Employer's testing or any other approved laboratory. Cement shall be stored on raised platforms inside stores covered on all sides and roof with provision for ample ventilation. Different types of cement shall be stored separately and more than ten bags (10) of cement shall not be stacked one above the other in the stack.

Sufficient space shall be left around the stacks for approach. Stacking shall be so arranged that bags from the oldest consignment in the stack can be conveniently removed first for use following the principle of first in first out (FIFO) basis. For this proper label tag indicating date of supply shall be displayed over the stack of stored cement received in a consignment (Batch). Cement which has hardened, clodded or deteriorated due to over stacking or long storage shall not be used in the works and shall be removed from the site immediately with intimation to Employer and Engineer/Consultant.

1.2.2 Aggregates: All aggregates shall conform to IS:383. Coarse aggregates shall be approved crushed stone or gravel, washed clean. Fine aggregates shall be approved river or pit sand. Coarse and fine aggregates shall be stored at site separately on clean and hard base or in separate compartments/hoppers. Samples of aggregates to be used shall be submitted to the Engineer/Consultant for approval before commencement of work. No aggregate shall be used without prior approval of the Engineer/Consultant. The Contractor shall ensure that over the entire period of construction all consignments of coarse and fine aggregates brought to the site conforms to the quality and grading as approved in the mix design by the Engineer/Consultant before the commencement of work.

If necessary, grading of aggregates shall be maintained by blending of different sizes of aggregates which shall be brought to site and stacked in separate stock piles. Whenever directed by the Engineer/Consultant, the Contractor shall perform tests at his own cost to satisfy the Engineer/Consultant that the grading and quality approved for coarse and fine aggregates are being maintained. Sampling of aggregates shall conform to IS:2430 and tests shall conform to IS:2386. The percentage to



flaky and elongated pieces should not exceed 15%. Aggregates shall be cleaned and free from any foreign materials.

- 1.2.3 Reinforcement: MS and medium tensile steel bars shall conform to IS:432 (Part-I & II), high strength deformed steel bars shall conform to IS:1786. All reinforcements shall be free from oil, paint, loose rust, mill scale, mud or other matter likely to weaken or destroy their bond with the concrete.
- 1.2.4 Binding wire: Binding wire shall be approved annealed black iron wire of 20 SWG.
- 1.2.5 Joint filler: Expansion joint fillers shall be approved non-extruding, resilient fillers.
- 1.2.6 Water stops: For all movement joints water stops used shall be of rubber, PVC or metallic sheets and shall be product of reputed manufacturer as per relevant IS codes and as approved by the Engineer/Consultant.
- 1.2.7 Waterproofing: The waterproofing compound/water-proofing membrane materials and treatment shall be of approved quality and manufacturer.
- 1.2.8 Water: Water shall be clean and reasonably free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Water shall conform to the quality as specified in clause 5.4 of IS:456.
- 1.2.9 Chemical Admixtures : These are material other than water, aggregates and cement (any selected type mentioned in clause 1.0 above), used as an ingredient of concrete or mortar and added to the batch immediately before or during its mixing to modify one or more of the properties of concrete in the plastic or hardened state. Dosages of retarders, plasticisers and super-plasticisers shall be restricted to 0.5, 1.0 and 2.0 percent respectively by weight of cementitious materials and unless a higher value is approved by Engineer/Consultant only after obtaining performance test from the manufactures. They shall conform to either IS:9103 and as per clause No. 5.5 of IS:456 or ASTM Designation C494-RS. Admixture are generally of the following types and are used depending on the requirement.
- 1.2.9.1 Water reducing Admixture : As per IS:9103 or ASTM C-494, which improves workability, accelerates the setting and early strength development of concrete.
- 1.2.9.2 Retarding Admixture : As per IS:9103 or ASTM C-494, which retards the setting of concrete.
- 1.2.9.3 Water Reducing Admixture, High Range : As per ASTM C-494, which reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.
- 1.2.9.4 Water Reducing and Accelerating Admixture : As per ASTM C-



494, which reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

1.2.9.5 Water Reducing and Retarding Admixture : As per ASTM C-494, which reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

1.2.9.6 Water Reducing, High Range and Retarding Admixture : As per ASTM C-494, which reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater and retards the setting of concrete, increase in both early and ultimate strengths.

1.3 Concrete Mix

1.3.1 All the concrete shall be 'Controlled Concrete' as defined by IS:456. The grades of concrete shall be as required. The Contractor shall at his own cost, grade the aggregate and control the water cement ratio, to design the different mixes of required strength and workability. The designed mix shall conform to the requirements of IS:456 and recommended guidelines for concrete mix design in IS:10262 and SP-23. The 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 in concrete work shall conform to Table 5 of IS:456. Adjustments to minimum cement contents for aggregates other than 20 mm nominal maximum size will be as per Table 6 of IS:456. All concrete (whether nominal or controlled) shall be machine mixed and no hand mixing will be allowed. Chemical admixtures may be used in the manufacture of concrete. The content, type, method and control of use and the locations and the products in which they are used shall be subject to the written approval of the Engineer/Consultant in each and every case.

The maximum size of aggregates shall be 40 mm. Where reinforcement is too closely spaced for the maximum size of stone in a range, the largest suitable range will be used with the approval of Engineer/Consultant. Before commencement of work the Contractor shall submit to the Engineer/Consultant for his approval complete details of the mix design calculations along with test results of different ingredients, grading analysis of the aggregates, the cube test results etc according to IS:10262. No concrete shall be placed on site until the Engineer/Consultant has approved the mix design. The concrete shall be of such consistency that it can be readily worked into the corners and angles of the formwork and around reinforcements without segregation of the materials or bleeding of free water at the surface.

If any change is made in the source and grading of the aggregates, strength of cement used, water content of the mix, manner of making, compacting the concrete or any other deviation from the



preliminary test procedure, the Engineer/Consultant may instruct for fresh preliminary test which shall be carried out by the Contractor at his own cost. Over the full period of construction the Contractor shall carry out works tests as per Clause 1.6 of this specification at his own cost to satisfy the Engineer/Consultant that correct grade of concrete is being used.

1.3.2 Where 'Nominal Mix Concrete' in case of M20 or lower as defined by IS:456 is permitted by the Engineer/Consultant for any specific reason, the proportion of materials shall be as indicated in Table-9 of IS:456. The water cement ratios shall not exceed those specified in Table-9 of IS:456. If the quantity of water is required to be increased for better workability the cement content also shall be proportionately increased so that the limit specified in Table-9 of IS: 456 is not exceeded.

1.3.3 Concrete for water retaining structures shall be as per IS: 3370.

1.4 Mixing

1.4.1 Batching Plant

All components of controlled concrete shall be proportioned by weight using concrete batching plant weigh batchers for each grade. Mixing shall be carried out in mechanical mixers but preferably a concrete batching plant shall be used. The mixer shall comply with IS:1791 and IS:12119. Volumetric mixing shall not be adopted unless specifically permitted by the Engineer/Consultant. The mechanical mixer shall be equipped with automatic devices for control of speed, gauging of water and timing the mixing period. The mixing shall be continued until there is a uniform distribution of materials and the mass is uniform in colour and consistency. For general guidance the mixing time shall be 2 mins. In case of other types of efficient mixers manufacturers recommendation shall be followed. Batches shall not exceed the capacity which can be mixed efficiently as determined by the mixer efficiency test and peripheral speed shall conform to manufacturer's recommended rate but shall not vary from $\pm 10\%$. Net minimum mixing time shall begin when ingredients including water is in the mixer. Excessive mixing shall be avoided. Weigh batchers shall be placed level during use and the hoppers shall be loaded evenly. The equipment shall be checked frequently to verify their accuracy. The concrete batching plant shall conform to IS:4925. The plant shall have mechanically operated mixers of approved size and type capable of ensuring a uniform distribution of the materials throughout the concrete mass. The mixers shall be completely emptied before receiving the materials of each succeeding batch. Precautions shall be taken to protect cement and concrete in wet weather. The plant shall be kept at all times well maintained and in particular it shall be kept free from adherent content. The calibration of the measuring instruments shall be checked periodically and particularly before all large pours of concrete.

1.5 Workability of Concrete



- 1.5.1 The concrete mix proportions chosen should be such that the concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available. Suggested ranges of workability of concrete measured in accordance with IS:1199 are given below:

Placing Conditions	Degree of workability	Slump
(1)	(2)	(3)
Blinding concrete; Shallow sections; Pavements using pavers	Very low	See 1.5.2
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
Heavily reinforced sections In slabs, beams, walls, Columns;	Medium	50-100
Slipform work; Pumped concrete	Medium	75-100
Trench fill; In-situ piling	High	100-150
Tremie concrete }	Very high	see 1.5.3

Note : For most of the placing conditions, internal vibrators (needle vibrators) are suitable. The diameter of the needle shall be determined based on the density and spacing of reinforcement bars and thickness of sections. For tremie concrete, vibrators are not required to be used.

- 1.5.2 In the 'very low' category of workability where strict control is necessary, for example pavement quality concrete, measurement of workability by determination of compacting factor will be more appropriate than slump (see IS:1199) and a value of compacting factor of 0.75 to 0.80 is suggested.

- 1.5.3 In the 'very high' category of workability, measurement of workability by determination of flow will be appropriate (see IS:9103).

1.6 Work/Laboratory Test

The Contractor shall carry out work/laboratory tests with cost implications as per provisions of clause 17.0 of General Conditions of Contract. Sampling, making up, curing and testing of specimen shall conform to IS:456, IS:516 and IS:1199 and other



test of the ingredients to be carried out periodically shall conform to IS:2386. Unless otherwise instructed by the Engineer/Consultant, frequency of work tests shall be as indicated below. The number of specimen to be tested and their criteria for acceptance shall be as per relevant clauses of IS:456. Report of the test results shall be submitted weekly to the Engineer/Consultant.

1.6.1 The Contractor shall provide at his own cost, concrete for the cube specimen, moulds for casting the specimen and also transport the cubes to the Employer's Contractor's laboratory for testing. The Contractor shall also provide all facilities, at his own cost, for sampling, casting, curing and storage of cubes until they are transported to the laboratory.

1.6.2 Testing of cube specimen will be carried out in Employer's laboratory, when the Contractor, if required, may be present. The presence of the Contractor's representative shall however not be a condition for carrying out the tests. (The cost of testing of cubes will be borne by the Employer).

1.7 Frequency of Test

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following :

Quantity of Concrete in the work, cum	Number of samples
1 – 5	1
6 – 15	2
16 – 30	3
31 – 50	4
51 & above	4 plus one additional sample for each additional 50 cum or part thereof.

Note : At least one sample shall be taken from each shift. Where concrete is produced at continuous production unit, such as ready-mixed concrete plant, frequency of sampling may be agreed upon mutually by suppliers and purchasers.

1.7.1 Test Specimen

Three test specimens shall be made for each sample for testing at 28 days. Additional specimen may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork, or to determine the duration of curing, or to check the testing error. Additional specimen may also be required for testing specimens cured by accelerated methods as described in IS:9013. The specimen shall be tested as described in IS:516.

1.7.2 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than



$\pm 15\%$ of the average. If more, the test results of the sample are invalid.

1.7.3 Acceptance Criteria of Concrete

1.7.3.1 Compressive strength

The Concrete shall be deemed to comply with the strength requirements when both the following conditions are met:

- a) The mean strength determined from group of four consecutive test results with the appropriate limit as per the table below.
- b) An individual test results complies with the appropriate limit as per the table below.

Characteristic Compressive Strength Compliance Requirement

Sl. No.	Specified Grade	Means of the Group of four (4) Non-overlapping Consecutive Test Results in N/mm ²	Individual Test
1.	M15	$\geq F_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5 N/mm ²) (fck + 3) N/m ² / whichever is greater <u>Results in N/mm²</u>	standard deviation or M20 Or Above
		$\geq (f_{ck}-3) \text{ N/mm}^2$	
		$\geq F_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5 N/mm ²) or (fck + 3) N/m ² / whichever is greater	
		$\geq (f_{ck} - 3) \text{ N/mm}^2$	

Note : In the absence of established value of standard deviation, the values given in Table-8 of Section-2 of IS:456 shall be taken.

1.7.3.2 Flexural strength

When both the above conditions are met, the concrete complies with the specified flexural strength:

- a) The mean strength determined from group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/m².
- b) The strength determined from any test results is not less than the specified characteristic strength less 0.3 N/mm².



- 1.7.3.3 Concrete is liable to be rejected if it is porous or honey combed, its placing has been interrupted in that providing a proper construction joint, the reinforcement has been displaced beyond the tolerance specified or construction tolerances have not been met. However, hardened concrete may be accepted after carrying out suitable test Inspection/testing of structures as per the discretion of Engineer/Consultant.

1.9 Formwork

- 1.9.1 Shuttering for concrete: The term 'Shuttering' shall include all centering and formwork required to support the concrete during the process of laying, compacting and setting and all items such as planking, lagging, walling, moulds, covers, cross-bearers, struts, props, bracings etc shall be covered by the term.

Shuttering shall be strong and rigidly constructed so that there may not be any deformation under weight and pressure of wet concrete, constructional loads, wind and/or other forces. It shall be constructed in such a manner that it can be easily removed afterwards.

The shuttering shall have smooth and even surface and so constructed as to remain sufficiently rigid during the placing and compacting of concrete and shall be sufficiently tight to prevent loss of liquid from the concrete.

Devices shall be provided in the shuttering for forming openings, holes, pockets, chases, recesses etc where required. Cutting of holes etc in the concrete after casting shall be avoided. Corner fillets shall be provided in the formwork to obtain chamfered edges to beams, columns, etc wherever required and the rate quoted shall be inclusive of the cost of carrying out such work.

Shuttering shall conform to IS:456 and IS:14687. Forms shall be prefabricated standard e.g. Doka system, British scaffolding system or approved equivalent or shop-built panels or built-in-place units, stiffened and braced. A smearing of oil release agent shall be given on the faces of the shuttering in contact with the concrete or mortar. Forms shall be cleaned from all dust and loose materials before applying oil release agent over it. Formwork with brick lining may be done for structures below ground level on earth face with prior permission of the Engineer/Consultant. Bricks shall be thoroughly wetted before laying concrete and the brick lining may be left in position, if so desired by the Contractor.

The shuttering shall be such that after its removal the exposed concrete surface shall be smooth and even. If any unevenness is found, the bulged portion of the concrete shall be chipped off and plastered with 6 mm thick cement plaster 1:4. No extra payment will be made for this.

- 1.9.2 Stripping Time: Forms shall not be released until the concrete has achieved a strength of at least twice the stress to which the concrete may be subjected at the time of removal of form work. The strength



referred to shall be that of concrete using the same concrete, aggregates and admixtures, if any, with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work.

- 1.9.2.1 While the above criteria of strength shall be the guiding factor for removal of formwork, in normal circumstances where ambient temperature does not fall below 15°C and where ordinary portland cement is used and adequate curing is done, following striking period may deem to satisfy the guideline given in clause 1.9.2.

Type of Formwork	Minimum Period before Striking Formwork
a) Vertical Formwork to columns, walls, Beams	16 – 24 h
b) Soffit formwork to slabs (Props to be refixed immediately after removal of formwork)	3 days
c) Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days
d) Props to slabs :	
1) Spanning upto 4.5 m	7 days
2) Spanning over 4.5 m	14 days
e) Props to beams and arches :	
1) Spanning up to 6 m	14 days
2) Spanning over 6 m	21 days

For other cements and lower temperature, the stripping time recommended above, may be suitably modified.

- 1.9.3 Supports: Formwork shall be so designed that the side of beams and slabs can be removed without disturbing soffit forms and their supports. Props and supports shall allow accurate adjustment of the formwork true to line and level and be capable of being removed in an approved sequence without injury to the concrete. Provision shall be made for removal of formwork without disturbing props required for supporting hardened concrete.

- 1.9.4 Setting: Panels and units shall be set to true dimensions and alignment and rigidly tied, walled and braced to prevent distortion and displacement during concreting. All joints shall be tight and close fitting to prevent leakage. At all construction joints, formwork shall be tightly secured against previously cast or hardened concrete. When fixing formwork for beams and slabs tight fitting



collars shall be provided around the heads of columns and the joints shall be made grout tight. Slip forms where used shall provide smooth even surface true to dimension and alignment and shall be free of unsightly off-sets, fins and bulges.

1.9.5 Ties: Standard form ties, clamps, bolts, inserts etc shall be of adequate strength. Spreaders, either removable or embedded type shall be used to maintain the wall thickness. The material and position of any tie passing through the formwork shall be as approved by the Engineer/Consultant. All tie members which will remain embedded in the concrete shall be fixed in a manner that will provide a minimum cover of 12 mm at both the ends. Any holes left after removal of ties shall be filled with concrete or mortar as approved by the Engineer/Consultant. Provision shall be made for forming holes and chases for services and for providing pipes, conduits and other fixing by the Engineer/Consultant.

1.9.6 Cleaning and treating of forms: All rubbish shall be removed from the interior of the formwork and inside of the formwork shall be wetted with water before commencing of concreting. Mould oil or other approved release agent shall be used to all panels. Care shall be taken to prevent contact of release agent with reinforcement.

1.10 Reinforcement

Workmanship shall conform to IS:2502. All reinforcements shall be free from loose mill scale, rust, oil, grease, mud and paint. Reinforcement shall not be bent or straightened in a manner that will injure the materials and all bars shall preferably be bent cold. Hot bending shall not be permitted for bars whose strength have been increased by cold working. Cutting and bending of reinforcement bars shall be made by using appropriate cutting and bending machine. No manual cutting and bending shall be allowed.

Reinforcement bars shall be placed and maintained accurately in position within tolerance limit as per IS:456. The correct cover to the reinforcement shall be maintained by use of precast concrete blocks.

All intersections of longitudinal and transverse bars or stirrups and all laps shall be securely tied together with approved binding wire. The binding wire shall be so placed that it touches all the four corners of the intersection and the two ends shall be looped with pliers and the ends shall be turned into the body of the concrete. The cost of the binding wire and spacer/cover blocks shall be included by the Contractor in his rate for reinforcement work.

Welded joints may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars connected. Welding shall be done in accordance with IS:2751 and special precautions shall be adopted for cold worked bars as per IS:9417 - 1979. Butt welding between the ends of a rod in line, whereby stress is



transferred across the section may be adopted only for mild steel bars. In case of tack welding for fixing reinforcements in their position, no special precaution need be taken.

1.11 Embedments

All embedments shall be accurately set and rigidly fastened. Anchor bolts shall be set to template and firmly secured in vertical and horizontal line at required positions. Water stops shall be secured against displacement during the placing of concrete. The joints for G.S sheet water stops shall be soldered water-tight and those of PVC and rubber shall be joined by cementing and vulcanising.

Anchor holes and anchor bolts shall be protected by covering suitably with brickwork in lean cement mortar after thorough cleaning.

1.12 Placing of Concrete

1.12.1 Transporting concrete: Concrete shall be transported from the Batching Plant by transit mixers to the forms as rapidly as possible by means that will prevent segregation or flash set in the concrete during hot weather. The containers shall be such as to prevent heavy evaporation. At the time of placing concrete in very hot weather, care shall be taken to see that the temperature of wet concrete does to exceed 38°C. Before placing the concrete, all formwork, embedments and reinforcement shall be checked for completeness, location, dimension, square and plumb. All chips and saw dust or other foul matter shall be removed from within the forms. The base surface shall be well moistened and puddles wiped up. Placing equipment and accessories shall be kept clean and free of partially set grout and concrete, and maintained in proper working order.

1.12.2 Placing aids: In general, placing shall be done by concrete pump. Wherever required, concreting shall be done by direct pouring from transit mixer and also of approved chute. Concreting shall also be done with the help of bottom open bucket wherever required. No head load of concrete pouring is allowed and use of wheel barrow is mandatory wherever direct pump concrete or other mechanical means are not suitable.

1.12.3 Conveying Equipment : Conveying equipment shall be approved and shall be of size and design such that detectable setting of concrete shall not occur before adjacent/next layer concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operation shall conform to the following additional requirements.

1.12.3.1 Truck mixers, agitators and agitating units and their manner of operation shall conform to the applicable requirements of ASTM C 94.



- 1.12.3.2 Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against under drying or rise in temperature. An approved arrangement shall be made at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged in to a hopper or through a baffle.
- 1.12.3.3 Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal, chutes more than 6 mtrs. long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
- 1.12.3.4 Pumping or pneumatic conveying equipment shall be of a suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump pumping or pneumatic conveying equipment shall not exceed 50 mm.
- 1.12.3.5 Concrete shall not be conveyed through pipe made of aluminium or aluminium alloy.
- 1.12.4 Construction joints & cold joints: In general construction joints shall be limited to the design requirement. In mass concrete, construction joints shall be made at breaks, offsets or other convenient levels as controlled by volume, plant capacity, time factors etc. Such construction joints shall be so located that they do not impair the strength of the structure and prior approval of the Engineer/Consultant are to be taken. In walls and column height of each lift shall not generally exceed 1.5 m as directed by the Engineer/Consultant. Method of forming all construction joints shall conform to the provisions of IS:456. The surface of previously placed concrete at the construction joint shall be thoroughly hacked to expose the coarse aggregates of previously placed concrete and cleaned with wire brush or any other approved means and high pressure water jet to remove all laitance and loose aggregates. Immediately before placing fresh concrete, such prepared surface shall be coated with a thin layer of cement slurry or cement sand mortar of proportion same as that of original concrete. Where high shear resistance is required at the construction joint, shear keys shall be provided.
- 1.12.5 Compaction: Concrete shall be thoroughly compacted and fully worked around the reinforcement, around embedded fixtures and into corners of the form work. Concrete shall be compacted by mechanical vibration using high frequency mechanically driven vibrators comply with IS:2505, IS:2506, IS:2514 & IS:4656. Concrete shall be placed in layers at least 300 mm deep in walls and approximately 450 mm in mass pours. Vibrators shall not penetrate more than into the surface of previously placed layer but



shall completely vibrate the working layer. Care shall be taken not to over-vibrate any concrete and especially those with higher slumps. Under no circumstances vibrators shall be attached to or allowed to touch reinforcement. Spare vibrators in good operating condition shall be on hand during placing operation.

- 1.12.6 Special concreting: The placing of under water concrete shall follow IS:456 in all respects for the method employed. Special types of concrete shall be placed by methods most suitable for the particular conditions.
- 1.12.7 Grouting bases of machines, columns, foundations bolts etc.
- 1.12.7.1 Level pads: For preparing the level pads, the top of the foundation concrete shall be chipped off to remove laitance formed on the concrete surface and all loose materials shall be thoroughly cleaned and the surface wetted before the grouting. In case level pads are constructed they shall be cement concrete with grade M30 in conformity with the grouting requirement with 6 mm size ballast. The top of the level pads shall be finished fine, true to level and be of size as indicated by the Engineer/Consultant.
- 1.12.7.2 Grouting: Before placing the grout, the concrete surface shall be thoroughly cleaned, preferably with compressed air and the surface shall be thoroughly wetted with water for several hours. Before placing the grout all free water shall be removed and the flat surface shall be coated with thin cement slurry. The quantity of mixing water should be minimum commensurate with the workability, compaction and filling of the grout in all corners and crevices. The grout shall be evenly spread and compacted by rodding or a vibrator. The grout shall be carefully observed for initial settlement. If any settlement is observed further grout is to be poured and rodded. For base plates having ribs underside the base plate, proper care is to be taken to ensure filling of the cavities between the ribs. In case of wide base plates of bed plates having ribs under- side it may be necessary to do pressure grouting.
- 1.12.7.3 Curing: The grout must not dry out after it is placed in position. The surface shall be kept moist with wet sacks for at least seven days.
- 1.12.7.4 Admixtures: If any admixtures is to be used with the grout, it shall be as approved by the Engineer/Consultant.
- 1.12.7.5 Non-shrinking grout: Non-shrinking grout where indicated or directed shall be placed in accordance with the method specified by the manufacturer. Material shall be as approved by the Engineer/Consultant.
- 1.12.8 Waterproofing: Waterproofing of concrete with approved waterproofing compound shall be carried out strictly in accordance with the manufacturer's specification.



1.13 Curing and Protecting

Curing of concrete with water shall comply with IS:456. The Contractor shall keep the exposed surfaces of concrete in a constantly wet condition for at least 7 days from the date of placing the concrete. Curing compound may be used subject to approval by the Engineer/Consultant. Finished floors and concrete shall be protected carefully until conditions shall comply with the code.

1.14 Repairing and Patching

Pockets, honey combing and other defects which may be formed due to segregation, improper vibration and any other reason whatsoever shall be completely repaired to the satisfaction of the Engineer/Consultant. The voids, if any, shall be properly keyed and reinforced, if necessary. The face shall be tightly formed and arranged for providing a head in the concrete. The cavity shall be filled with the same concrete as used for the structure and thoroughly rodded or vibrated where possible. The concrete sets sufficiently to stay in place. While still 'alive', the upper part of form hopper shall be removed and excess concrete struck off and finished with wood flat or trowel to match existing concrete. Any fins or unsightly grout runs or bulges shall be removed from surfaces exposed to view. The rod holes shall be finished with cement or grouted to match the existing surface as closely as possible. No cement wash shall be used unless directed by Engineer/Consultant.

1.15 Tolerances for Formwork

The Formwork shall be designed and constructed so as to remain sufficiently rigid during placing and compaction of Concrete and shall be such as to prevent loss of slurry from the Concrete. The tolerances on the shape, line and dimensions as shown in the approved drawing shall be within limits as given in the Table of clause no 11.1 of IS:456

1.16 Tolerances for Placing of Reinforcement

Unless otherwise specified, the Reinforcement shall be placed within the following tolerances :

- | | | | |
|----|--------------------------------------|-------------|----|
| a) | For effective depth 200 mm or less | ± 10 mm | b) |
| | For effective depth more than 200 mm | ± 15 mm | |

1.17 Tolerances : The permissible deviations in dimensions and positions of structural members shall not exceed the following limits:

- a) Deviations from the vertical for the whole height of construction



- i) for foundations .. 20 mm
- ii) for walls and columns supporting monolithic floors .. 15 mm
- iii) for columns of a frame which are connected with crane and truss beams .. 10 mm
- iv) for structures placed in a sliding form .. 1/500 of the height of the structures but not more than 100 mm

- b) Deviations from horizontal planes
 - i) over 1 m of the plane in any direction .. 5 mm
 - ii) over the whole plane in buildings .. 10 mm
 - iii) over the whole plane in structures .. 20 mm
 - iv) local deviations of the upper surface of concrete when measurements are made of the structural components (except surfaces at supports) .. 8 mm

- c) Deviations of structural components in length or span .. +20 mm

- d) Deviations of structural components in cross-section .. +8 mm

- e) Deviations in level of surface and embedded fixtures serving as supports .. +5 mm

- f) Deviations in disposition of anchor bolts
 - i) in plan, when the disposition is within the contour of a support .. +/- 5 mm
 - ii) when the disposition is outside the contour of a support .. +/- 10 mm
 - iii) in height .. +20 mm

- g) Deviations in laying out axes of foundations, footings and other metal structural parts having unmilled ends

1.1 L mm, where L is the size of the span or pitch of the structural parts in meter.



FOR ANY OTHER CLARIFICATION/REFERENCES, YOU MAY REFER THE SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (up-gradation of third revision) UNDER MINISTRY OF ROAD TRANSPORT AND HIGHWAYS (MORTH)) OR THE OWNER.