

Only standard cartridge explosives, prepared and packaged by explosive manufacturing firms shall be used in presplit holes. These shall be fired as recommended by the manufacturer. Ammonium nitrate composition blasting agents will not be permitted in presplitting operations.

Stemming may be required to achieve a satisfactory presplit face. Stemming material shall be dry free-running material all of which passes 11.2 mm sieve and 90% of which is on 280 mm sieve. Stemmed presplit holes shall be completely filled to the collar.

All charges in each presplitting pattern shall be detonated simultaneously

303.3 Tolerances: The presplit face shall not deviate more than 300 mm from the plane passing through adjacent drill holes, except where the character of the rock is such that as determined by the Engineer, irregularities are avoided. When completed the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slope shall vary from the designated slopes by more than $3(X)$ mm. These tolerances shall be measured perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the side drains.

As long as equally satisfactory presplit slopes are obtained, then either the slope face may be presplit before drilling for production blasting or presplitting the slope face and production blasting may be done at the same time, provided that the presplitting drill holes are fired with zero delay and the production holes are delayed starting at the row of holes farthest from the slope and progressing in steps to the row of holes nearest the presplit line which row shall be delayed at least 50 milliseconds. In either case the presplitting holes shall extend either to end of the excavation or for a distance of not less than 15 m beyond the limits of the production holes to the detonated.

303.4. Measurements for Payment: The area of presplitting to be paid for will be measured as square meters of acceptable presplit slope surface.

303.5. Rates: The Contract unit rate for presplitting work shall be payment made in full for carrying out the required operations for obtaining acceptable presplit slope surfaces. The quantity of rock excavated through the production! Presplit holes shall be paid for as per Clause 301.9.1.

304. EXCAVATION FOR STRUCTURES

304.1. Scope : Excavation for structures shall consist of the removal of material for the construction of foundation for bridges, culverts, retaining walls, headwalls, cutoff walls pipe culverts and other similar structures, in accordance with the requirements of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other.

151 Deleterious matter and obstructions, necessary for placing the foundations, trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material

304.2. Classification of Excavation: All materials involved in excavation shall be classified in accordance with Clause 301.2.

304.3. Construction Operations

304.3.1. Setting out: After the site has been cleared according to Clause 201, the limits of excavation shall be set out true to lines curves and slopes to Clause 301.3.1.

304.3.2. Excavation: Excavation shall be taken up to the width of the lowest step of the footing and the sides shall be left plumb when the nature of soil allows it. Where - the nature of soil or the depth of the trench or season of the season do not permit vertical sides, the Contractor at his own expense shall split up necessary shoring, strutting and planing cut slopes to a safer angle or both with due regard to the safety of the personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone form an adjoining structures within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

Where blasting is to be resorted to the same shall be carried out in accordance with Clause 302 and all precautions indicated therein observed. Where blasting is likely to be resorted to, the Contractor shall take such precautions as may be necessary, including providing rubber mat cover to prevent flying of debris etc. shall be taken to prevent any damage.

304 Dewatering and protection : Normally, open foundations shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain other reasons, the contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well point system, cofferdams and other necessary works to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and the safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as water tight as is necessary for

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facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipments, etc., inside the enclosed area.

If it is determined beforehand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.

Pumping from the interior of any foundation enclosure shall be done in such a manner to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.

The Contractor shall take all precautions in diverting channels and in discharging the drain water as not to cause damage to the works, crops or any other property.

304.3.4. Preparation of Foundation: The bottom of the foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown, on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the foundation at the cost of the contractor as per Clause 2104.1. Ordinary filling shall not be used for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and put to a firm surface either level and stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar, or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footing shall be filled with lean concrete (91:3:6 nominal mix) upto the top level of rock.

If the depth of fill required is more than 1.5 m above the top of the footing, filling, upto 1.5 m above top of footing shall be done with lean concrete (1:3:6 nominal mix) following by boulders grouted with cement.

When foundation piles are used, the excavation of each pit shall be substantially completed before 1 pile - driving operations therein. After pile driving operations in a given pit are completed, all loose and displaced materials therein shall be removed to the elevation of the bottom of the footing.

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shall be removed by the Contractor at his own cost.

304.3.6. Public safety: Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS:3764.

304.3.7. Backfilling : Backfilling shall be done with approved material after concrete masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve a density not less than the field density before excavation.

304.3.8. Disposal of surplus excavated materials : Clause 301.3.11 shall apply.

304.4. Measurements for Payment: Excavation for structures shall be measured in cum. for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer. Excavation over increased width, cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the Contractor in executing the work and shall not be measured and paid for separately.

Preparation of rock foundation shall be measured in square meters. Foundation sealing, dewatering, including pumping shall be deemed to be incidental to the work unless separate provision is made for the Contract. In the latter case, payment shall be on lumpsum basis as provided in the Bill of Quantities.

304.5. Rates

304.5.1. The Contract unit rate for the items of excavation for structures shall be payment in full for carrying out the required operation including full compensation for.

- i. Setting out;
- ii. Construction of necessary cofferdams, cribs, sheeting, shoring and bracing and their subsequent removal;
- iii. Removal of all logs, stumps, grubs and other deleterious matter and obstruction; for placing the foundation including trimming of bottoms of excavations;
- iv. Foundation sealing, dewatering including pumping when no separate provision for it is made in the Contract;
- v. Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads up to 10 m or as otherwise specified; and
- vi. All labour, materials, tools, equipment, safety measures, diversion of traffic and incidentals necessary to complete the work to Specification

304.5.2. The Contract unit rate for preparation of rock foundation shall be full compensation for cutting, trimming and cleaning the foundation surface and filling sealing of all seams with cement grout or mortar including all materials, labour and incident for completing the work.

304.5.3. The Contract unit rate for transporting material from the excavation for structures shall be full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transpiration involved beyond the initial lead of 1000m.

all labour, materials, tools equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 cum. in girth as well as stumps left over after cutting of trees carried out by another agency Excavation and backfilling where necessary, and for handling, salvaging, piling and disposing of the cleared materials with all lifts and upto a lead of 1000 meters or as otherwise specified.

201.6.2 The contract unit rate for cutting trees above 300 mm in girth shall include removal of stumps as well shall include excavation and backfilling to required compaction, handling salvaging piling and disposing of the cleared materials with all lifts and upto a lead of 1000 m.

201.6.3 Where a contract does not include separate items of clearing or grubbing, the same shall be considered incidental to The earthwork items and the contract unit prices the same shall be considered as including clearing and grubbing operations.

202.1 DISMANTLING CULVERTS, BRIDGES, AND OTHER STRUCTURES! VEMENTS (NOT REQUIRED)

202.1 SCOPE :

This work shall consist of removing as hereinafter setforth, existing culverts, bridges, pavements, kerbs and other structures like guard rails, fences, utility services, manholes, catch basins, inlets, etc., which are in place but interfere with the new on or are not suitable to remain in place, and of salvaging.

CEMENT CONCRETE OR STRUCTURES

SECTION 1700

1701. GENERAL

These specification cover the requirement of cement for use in various component of higher structures.

For all items of concrete in any structural portion of the road pavement, culvert and bridge or its components, design mix concrete shall be used unless otherwise specified.

1702. GRADES OF CONCRETE :

The concrete shall be in grades designated below where the characteristic strength is defined as the strength below which not more than 5 percent of the test results are expected to fall.

M15	15
M20	20
M25	25
M30	30
M35	40
M40	40
M45	45
M50	50
M55	55

For reinforced concrete lowest grade permitted is M 20 and for plain concrete lowest grade permitted is M 15.

For prestressed concrete work, the specified characteristic compressive strength shall not be less than 35 MPa, i.e., grade M 35, except for composite construction where concrete of grade M 30 could be permitted for deck slab.

Concrete used in any structure shall be apart from its grade designation, specified either as "Design mix concrete" or "Nominal mix concrete."

1703. STRENGTH REQUIREMENT OF CONCRETE

1703.1. DESIGN MIX CONCRETE

Design mix concrete is that concrete for which the design of the mix; i.e., the determination of the proportions of cement, aggregates and water is arrived at to have a target mean strength in each grade of concrete as given below:

Grade of concrete	Target mean strength
M20	MPa
M25	36 MPa
M30	42 MPa
M35	47 MPa
M40	52 MPa
M45	58 MPa
M50	63 MPa
M55	69 MPa

The mix design shall be done as per IS:10262 (Recommended guidelines for mix design) or on the basis to any rational method.

1703.2 NOMINAL MIX CONCRETE

Nominal mix concrete is that concrete for which the concrete mix is not required to be designed by tests and in which the proportions of material shall be in accordance with Clause 1706.2.

1704. ADMIXTURES

No material other than the essential ingredients, i.e, cement, aggregates and water shall ordinarily be used in the manufacture of concrete or mortar. But the Engineer may permit the use of approved admixtures conforming to IS : 6925 for imparting special characteristics to the concrete, 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.

1705 SIZE OF COARSE AGGREGATES

Aggregates shall consist of (i) coarse aggregates of sizes 4.75 to 40 mm and (ii) fine of sizes 0.15 to 4.75 mm but the actual size of aggregates to be used on any be in accordance with the following clauses.

The preferred nominal sizes of aggregate is 20 mm for reinforced concrete, larger sizes upto 31.5mm may be permitted in special cases where there is no restriction to flow of concrete in a section if smaller sizes are necessary for any element, 10 mm and 12.5 be used.

For plain concrete, preferred nominal sizes shall be 20 mm and 40 mm and larger sizes may be permitted only in special cases, subject to supplement specifications and precautions.

Grading of aggregates shall be such as to produce a dense concrete of the specified strength. Which will work readily into position without the use of excessive water content.

1706. PROPORTIONING CONCRETE

1706.1 DESIGN MIX CONCRETE

Mix shall be designed on the basis of preliminary tests. 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.

of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions as required. Different sizes, however, 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 is determined by the Engineer to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates. 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 important to keep the water-cement ratio constant and its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined as frequently as possible, frequency for a given job being determined by the Engineer 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 : 2336 (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.

In both plain and reinforced concrete, the values given, in Table 1700-1 regarding minimum cement content and water cement ratio shall be followed.

For reinforced cement concrete work the minimum grade of concrete to be used under moderate conditions of exposure and severe conditions of exposure shall be M 20 and M 25 respectively.

Nominal mix concrete shall generally be specified by grades of concrete.

Nominal mix concrete may be used for grades M15 and M 20 and not for any higher grade. Proportions for nominal mix concrete are given in Table 1700-3.

TABLE 1700 -3. PROPORTIONS FOR NOMINAL MIX CONCRETE

Grades of concrete	Total quantity (Kg) of dry aggregate by mass per 50 Kg of cement to be taken as sum of the individual	Proportion of fine aggregate to coarse aggregate (By mass)	Quantity of water per 50 Kg of cement (Max. liters)
M15	350	General 1:2 subject to an upper limit of 1:1 and half and a lower limit of 1:2 1/2. 30	32

Note : The proportions of fine to coarse aggregate should be adjusted from upper limit of lower limit progressively as the grading of fine aggregates becomes finer and the maximum size of coarse aggregates becomes larger. Graded coarse aggregates shall be used.

1707. MIXING CONCRETE

For all works, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained, and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount. In no case shall the mixing be done for less than 2 minutes after all ingredients has been put into the mixer.

When hand mixing is permitted by the Engineer for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall so be arranged that no foreign material shall get mixed with concrete nor does the mixing water follow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry sand and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a hose and the mass turned over till a mortar of required consistency is obtained. Measured quantity of coarse aggregate shall then be placed on

In the case of reinforced concrete Work, the workability shall be such that the concrete shall surround and properly grip all the reinforcement.

TABLE 1700-1

Conditions of Exposure	Plain Concrete		Reinforced Concrete	
	Minimum cement content Kg/cum	Maximum water cement ratio	Maximum cement content Kg/cum	Maximum water cement ratio
1. Severe-Marine environment, alternate wetting and drying due to sea spray, alternative wetting and drying combined with freezing and buried in soil having corrosive effect.	310	0.45	400	0.40
2. Moderate -other than those mentioned above	250	0.50	310	0.45

Notes :

1. The minimum cement content is based on 19 mm aggregate. For 37.5 mm aggregate it should be reduced by 10 percent.
2. For portions of structures in contact with water, where the velocity and bed material likely to cause corrosion of concrete, the condition of exposure shall be assumed to severe.

The cement concrete of mix specified in Table 1700-1 shall be proportionately increased if the quantity of water in mix has to be increased to overcome the difficulties of placement and compaction, so that the water-cement ratio as specified is not exceeded.

For prestressed concrete, the concrete mix shall comply with the minimum cement content and water-cement ratio as given in table 1700-2 and at the same time the quantity of cement in the concrete mix shall not be more than 540 Kg/cum of concrete.

TABLE 1700-2

Exposure	Minimum cement content (Kg cum)	Maximum water cement ratio
Server : For example, exposed to saline atmosphere of freezing whilst wet or corrosive fumes	400	0.45

segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the form work.

When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself.

CEMENT CONCRETE FOR STRUCTURES SECTION 1700

This 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete.

When concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed, and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work, particular attention being given to corners and close spots.

Concrete shall be thoroughly compacted by vibration or other means during placing, and worked around the reinforcement, tenders or dust formers, embedded fixture into the corners of the framework to produce a dense homogeneous void free mass having the required surface finish. When vibrators are used, vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has partially ceased and in a manner that does not promote segregation. Over vibration shall be avoided to minimise the risk of forming a weak surface layer. When external vibrators are used, the design of framework and disposition of vibrator shall be such as to ensure efficient compaction and to avoid surface blemishes. Vibration shall not be applied through reinforcement and where vibrators of immersion type are used, contact with reinforcement and all inserts like ducts, etc., shall be avoided. Additional vibrator in serviceable condition shall be kept at site so that they can be used in the event of breakdowns.

Mechanical vibrators used shall comply with IS: 2505, IS: 2506, IS: 2514 and IS: 4656

1709. CONCRETING UNDER WATER

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of the mix to be used shall be got approved from the Engineer before any work is started. Such concrete shall not be considered as "Controlled Concrete".

Concrete shall contain 10 percent more cement than that required for the same placed in the dry. The material shall be so proportioned as to produce a concrete having a slump of not less than 100 mm, and not more than 180 mm. The slump shall be tested as per IS: 516.

Concrete shall contain 10 percent more cement than that required for the same placed in the dry. The material shall be so proportioned as to produce a concrete having a slump of not less than 100 mm, and not more than 180 mm. The slump shall be tested as per IS: 516.

Coffer dams or forms shall be sufficiently tight to ensure still water conditions if practicable and in any case to reduce the flow of water to less than 3 meters per minute the space into which concrete is to be deposited. Cofferdams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the walls. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter.

Concrete shall be deposited continuously until it has been brought to the required height. While depositing, the top surface shall always be kept as nearly level as possible and formation of seams avoided. For depositing concrete any one of the following methods may be used:

a) Tremie—when concrete is to be deposited under water by means of a tremie, the top section of the tremie shall be a hopper large enough to hold one full batch of the mixture and the entire contents of the transporting bucket. If any. The tremie pipe shall not be less than 200 mm in diameter, and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even when a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength for the job shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete through the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end. Thus establishing a continuous stream of concrete, it will be necessary to raise slowly the tremie in order to allow a uniform flow of concrete, but it shall not be emptied so that water enters above the concrete in the pipe. At all times after the placing of concrete is started and until all the required quantity has been placed, the lower end of tremie pipe shall be kept below the top surface of the plastic concrete. This will cause the concrete to build up from below instead of flowing out over the surface, and thus avoid formation of layers of laitance. If in the tremie is lost while depositing, the

move freely downward and outward tripped. The bucket shall be filled completely and lowered slowly to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

To minimise the formation of laitance, great care shall be exercised not to disturb the concrete as far as possible which it is being deposited.

1710. CURING OF CONCRETE

1710. 1 PROTECTION AND WATER CURING

Curing is the process for preventing the loss of moisture from the concrete. The prevention of moisture loss from the concrete is particularly important if the water cement ratio is low.

Curing the protection shall start immediately after the compaction of the concrete to protect it from:

- a) Prematured drying out particularly by solar radiation and wind.
- b) Internal thermal measurements.
- c) Leaching out by rain and flowing water.
- d) Rapid cooling during the first few days after placing.
- e) Low Temperature of frost.
- f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

Where members are of considerable size and length, with high cement, accelerated curing methods are to be applied, as approved in details by the Engineer.

Exposed surfaces of concrete shall be kept continuously in a damp wet condition by ponding or by covering with a layer of sacks, canvas, hessian, or similar materials and shall be kept constantly wet for a period of not less than fourteen days from the date of placing the concrete.

Masonry work over the foundation concrete may be started after 4 hours of its laying but the curing the concrete shall be continued for a minimum period of 14 days.

1710.2 STEAM CURING

Where steam curing is adopted it shall be ensured that it is done in a suitable enclosure to contain the live steam in order to minimise moisture and heat losses. The initial application of the steam shall be from two to four hours after the final placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased from four to six hours.

The steam shall be at 100 percent relative humidity to prevent loss of moisture and provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete, and the ambient air temperature shall increase at a rate not exceeding 50 °C per hour until a maximum temperature of 60° C to 70° C is reached. The minimum temperature shall be maintained until the concrete has reached the desired strength.

When steam curing is discontinued, the ambient air temperature shall not drop at a rate exceeding 5° C per hour until a temperature of about 10°C above the temperature of the air to which the concrete will be exposed, has been reached.

The concrete shall not be exposed to temperatures below freezing for at least six days after casting.

1911. WORKING IN EXTREME WEATHER.

Where concrete is to be deposited at or near freezing temperatures, precautions shall be taken to ensure that at the time of placing it has a temperature of not less than 4, 5°C and that this temperature after it has been placed and compacted is maintained until it has thoroughly hardened. When necessary the ingredients shall be heated before mixing and concrete carefully protected, after placing in general, heating the mixing water alone to about 60°C may be sufficient for this purpose. Dependence shall not be placed on salt or other chemicals for the prevention of freezing. Calcium chlorided upto 1. ½ percent by weight of the cement can be used to accelerate the rate of hardening providing it does not accelerate corrosion. Use of calcium chloride in excess of this percentage is considered harmful. No frozen material or materials containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to freezing weather shall be entertained air and the water content of the mix shall not be exceed 30 liters per 50 Kg. of cement.

1712. FINISHING

Immediately after the removal of forms, all exposed bars or bolts passing through the reinforced cement concrete member and used for shuttering or any there purpose shall be cut inside the reinforced cement concrete member to a depth of at least 25mm below the surface of the concrete and the resulting holes be closed by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other

of all voids, surfaces which have been pointed shall be kept moist for a period of twenty four hours.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filter shall be left exposed for its full length with clean and true edges.

If rock pockets/honey-combs; in the opinion of the Engineer are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

1713. CONSTRUCTION JOINTS

Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown on approved drawings as directed by the Engineer. Such joints shall, however, be kept to the minimum.

For a vertical construction joint, a stopping board shall be read previously at the predetermined position and shall be properly stayed for sufficient lateral rigidity to prevent its displacement or bulging when concrete is compacted against it. Concreting shall be continued right upto the board. The board shall not removed before the expiry of the specified period for removal of vertical forms.

Before resuming work at any construction joint when concrete has not yet fully hardened all laitance shall be removed thoroughly, care being taken to avoid dislodgement of coarse aggregates. When work has to be resumed on a surface which has hardened it shall be thoroughly hacked, swept clean, wetted and covered with a layer of neat cement grout. The neat cement grout shall be allowed by a 10mm thick layer of mortar mixed in the same proportion as in concrete and concreting resumed immediately thereafter. The first batch of concrete shall be rammed against the old work to avoid formation of any stone pockets, particular attention being paid to corners and close spots.

In pre stressed concrete structures construction joints shall be avoided, as far as possible, specially in the area of tensile stresses, but where necessary, concreting shall be carried out continuously upto such joints which shall preferably be transverse to the line of main compression. In all cases, the position and detailed arrangement of all construction joints shall be predetermined and got approved by the engineer.

1714. TESTS AND STANDARDS OF ACCEPTANCE
Random sampling and lot by lot acceptance inspection shall be made for the 28 day
cube strength of concrete.

1714.1 Concrete under acceptance shall be notionally divided into lots for the purpose
sampling, before commencement of work. The delimitation of lots shall be determined
by the following:

- i) No individual lot shall be more than 30 cum in volume.
- ii) At least one cube forming item of sample representing the lot shall be taken from
concrete of the same grade and mix proportions cast in any day.
- (iii) Different grades of mixes of concrete shall be divided into separate lots.
- iv) Concrete of a lot shall be used in the same identifiable unit of the bridge.

1714.2 SAMPLING AND TESTING.

- 1) Concrete for making one test cube shall be taken from a batch of concrete at point of
discharge from the mixer according to procedures laid down in IS: 1199.
- 2) A random sampling procedure to ensure that each of the concrete batches forming
the lot under acceptance inspection has equal chance of being chosen for taking cube
shall be adopted.
- 3) 150mm cubes shall be made, cured and tested at 28 days age for compressive
strength conforming to IS: 516. The 28 days.

Test strength result for each cube shall form an item of the sample representing a lot.

1714.3 SAMPLE SIZE

A sample shall represent a lot under inspection. A test strength result of a cube (xi) shall
be termed as an item of the sample and the number of such items (n) shall define the
sample size.

A fixed sample size of $n=10$ shall be used for the acceptance decision for any lot
irrespective of lot size.

1714.4 ACCEPTANCE CRITERIAL

$x > f_{ek} - 3(2)$

where

f_{ek} = Characteristic strength of concrete specified.

n = Sample size = 10

x = Value of any individual item of the sample i.e. 28 days test strength of any cube of the sample.

\bar{x} = Sample mean or mean value of 10 cube strength of the sample.

s = Sample standard deviation computed from 10 individual cube strength results.

(b) Both criteria (1) and (2) must be satisfied simultaneously. Satisfaction of the criteria alone will not be deemed as compliance. VV

(c) Acceptance decision will be taken lot by lot and, in no case shall the sample from separate lots be combined for the purpose of acceptance.

1715. USE OF PLUMS IN ORDINARY CONCRETE

Stone plums shall not be used unless specified on the drawings. When used, the size of stone plums may be from 150 to 300 mm. The maximum dimension of these stones or plums shall not exceed 1/3 or the least dimension of the members.

All plums shall be hard, durable, clean and free from soft materials or loose, peaces or deleterious substance in them and shall not have sharp corners.

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of at least two and a half times the thickness of the maximum size of plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plums under their own height. These plums shall be about half embedded in their concrete and the part exposed so as to form a key with the next layer of concrete no plums shall be used for concrete laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from plums to the other surface from any steel reinforcement shall be equal to greatest width of the plum.

concave faces shall be laid-with the concave upwards.

The thickness of the next and successive layers of concrete shall be at least twice the largest plums.

The total volume of plums shall not exceed 15 percent of the volume of the concrete.

1716. MEASUREMENTS FOR PAYMENT

The cement concrete shall be measured in cubic meters in reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as run continuously through and the beam as the portion below the slab.

1717. RATE

The contract unit rate for concrete shall include the cost, of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing per directions of the engineer, curing and all other incidental expenses for producing concrete of specified strength to complete the structure of its components as shown on the drawings and according to these specifications. The contract unit rate shall also include the cost of making, fixing and removing of all centres and forms required for the work unless otherwise specified in the Contract.

Stone masonry for the structures

Section 1400

1401. Materials

Stone shall be of the type specified. It shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used.

The stones when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS: 1124.

The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 150mm

Other used in stone masonry shall conform to section 1000

Mortar used in stone masonry shall conform to clause 1301