

## **SURAT MUNICIPAL CORPORATION**

### **SOUTH ZONE-A (Udhana)**

**TENDER NOTICE NO. DMC/SZ-A/01/2026-27**

## **VOLUME III –Technical Specifications**

**Name of Work:- Construction of 18.23 mt T.P CC Road from F.P.No.29/C to F.P.No.41 in T.P.No.58 (Bamroli) in South Zone-A (Udhana) (3<sup>RD</sup> Attempt)**

LAST DATE & TIME OF ONLINE BID SUBMISSION: - 02/06/2026 UP TO 18.00 Hrs. (IST)

LAST DATE & TIME OF PHYSICAL SUBMISSION: -10/06/2026 UP TO 18.00 Hrs. (IST)

**General**

- 1.1 Part A of technical specification contains item wise technical specification as per BOQ and amendment/modification of existing clauses of Specification for Road & bridge works (MORT&H).
- 1.2 Specification for Road & bridge works (MORT&H) (fifth revision – 2013) shall be followed wherever specified. “Sections” and “Clauses” mentioned in these specifications refers corresponding sections and clauses of Specification for Road & bridge works (MORT&H).
- 1.3 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specifications of IRC, BIS, BS, ASTM, AASHTO and CAN/CSA in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the Engineer and in case of any dispute arising out the interpretation of the above, the decision of the Municipal Commissioner, SMC shall be final and binding on the Contractor.

**Item wise technical specification as per BOQ**

Item wise technical specification as per BOQ are as follows:

## Part- (A) Cement Concrete Road

### Section: 1 Site Clearance

#### *Item No:1.01 Dismantling of structures*

***1.1 Dismantling of structures on roadway, including disposal of unserviceable material and utilising the serviceable material free of cost in permanent works as directed by the Engineer with all leads and lifts etc. complete***

SECTION 200	SITE CLEARANCE
Clause 201.1 (Addition)	<b>Scope</b>
	<p>Clearing and grubbing shall be performed less than one month in advance of earthwork operations and in accordance with the requirements of these specifications. If any vegetation grows after clearing and grubbing and before earth work, the contractor shall repeat the work to the satisfaction of the Engineer without any extra cost. Areas requiring clearing and grubbing shall be determined by the Engineer.”</p> <p>Brick/Stone masonry, Plain Concrete, Reinforced Concrete, Bituminous Pavement and Non-Bituminous Pavement are required to be removed under this Item with unit of measurement as Cum.</p>
Clause 201.2	<p><b>Dismantling Pavements and Other Structures</b></p> <p>In removing pavements, kerbs, gutters, and other structures like guard-rails, fences, manholes, catch basins, inlets, etc., Where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.</p> <p>All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cu.mt. and used with the approval of the Engineer or disposed of.</p>
Clause 201.3	<p><b>Back-filling</b></p> <p>Holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and compacted to required density as directed by the Engineer.</p>
Clause 201.4 (Modification)	<p><b>Disposal of Materials</b></p> <p>Replace “1000m” with “anylead” in the second paragraph, last sentence.</p>
Clause 201.5	<p>Measurements for Payment</p> <p>Add the following sentence in first paragraph: Removal of trees including stumps and roots of trees of any girth less than 300 mm shall not be measured separately. It shall be incidental to</p>

	clearing and grubbing work. Tree cutting including removal of stumps & roots having girth 300 mm and above shall be measured in nos and payment shall be made as per rates indicated in BOQ.
Clause 201.6	Rates
Clause 201.6.1 (Modification)	Replace “1000m” with “all leads and lifts” in the last sentence.
	The contract unit rates for the clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will include removal of stumps and roots of trees less than 300 mm in girth. Also include removal of stumps of any size and roots of trees of any girth left over after cutting of trees carried out by the contractor or any other agency. The excavation and backfilling to required density where necessary and handling, salvaging, piling and disposing of the cleared materials with all lifts up to any lead.
(Addition)	Add the following paragraph: “The removal from site and disposal of all materials obtained from clearing and grubbing operations, which, in the opinion of the Engineer cannot be used or auctioned, shall be included in the Contract unit rate” Surplus material, which in the opinion of the Engineer cannot be used in the works, shall be removed from site by the Contractor and disposed of at all lead and lifts. The Contractor will locate the place for disposal of surplus material, SMC will not make available the place for disposal of material and no claim will be entertained on that account, surplus material in the opinion of Engineer Incharge will be the properties of contractor
Clause 201.6.2 (Modification)	Replace “1000m” with “all leads & lifts” in last sentence

### ***Item No: 1.02 Fixing of traffic signs***

***1.02 Provision and fixing of traffic signs for limited period at suitable locations in construction zone comprising of warning zone, approach transition zone, working zone and terminal transition zone with a minimum distance of 60 cm from the edge of the kerb in case of kerbed roads and 2 to 3 m from the edge of the carriageway in case of un-kerbed roads, the bottom edge of the lowest sign plate to be not less than 2 m above the road level, fixed on 60 mm x 60 mm x 6 mm angle iron post, founded and installed as per approved design and drawings, removed and disposed of after completion of construction work, all as per IRC:SP:55-2001.***

Excavated surface The contractor shall have to fix all the traffic signs for limited period at suitable locations in the reference of drawings in the volume IV in the compliance of IRC: SP:5-2001.

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***Item No: 1.03 Providing and installation of barricades***

***1.03 Providing and installation of barricades including supplying, painting with fluorescent paint and fixing 1.25mm th. M.S. CRC Plates with MS Channel ISMC 100 x 50 mm of 1.8m height and M.S. angle 50 x 50 x 5 mm at 2.5m c/c and dismantling the same after completion of work as directed by Engineer and as per site requirements.***

Payment for barricading as per BOQ (Vol.2 of tender) shall be made after completion of work of stretch on which the erection of barricading done by the contractor of before completion of work the barricading may found dismantled / removed or disturbed then it will not be entitled for any payment. During execution of work if at particular location contractor is instructed to do barricading and if barricading is not erected than contractor shall be levied penalty at the rate of Rs.100 per sq.mt./day for such non-performance.

**Shifting of barricades**

Shifting of barricades same as per requirement during construction period and dismantling the same after completion of work as directed by Engineer and as per site requirements.

There should be provision of clear procedures/ written guidance describing the key information to be exchanged during shift.

Shifting should be conducted in presence of engineer in-charge

Shifting of barricades records should be maintained and analyzed for payment as per rate mention in vol 02.

Before working on road or along road side, the executing agency shall obtain approval for working on road from Safety Department. Barricade to control or to protect traffic is to be provided as per the norm mentioned below and to be approved by the site-in-charge and the safety officer of the concerned department before starting the job.

Care should be taken to block only one-half of road width at a time. Caution boards and boards indicating diversion are to be placed at both sides of barricade.

Care should be taken while shifting, no damage of the permanent type barricading material for reuse that barricading for next project. If there is found some damages or dismantling of the barricade, it should be paid by contractor.

***Item No: 1.04 Reuse and shifting of barricades***

***1.04 Reuse and shifting of barricades same as per requirement during construction period and dismantling the same after completion of work as directed by Engineer and as per site requirement.***

Reuse of the above barricades in **item 1.03** for traffic safety purpose without procuring new barricades.

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***Item No: 1.05 Providing, fixing and maintaining the blinkers******1.05 Providing, fixing and maintaining the blinkers at site during construction period as directed by Engineer-in-charge***

Contractor will have to provide and maintaining the blinker during the construction period as per instruction of Engineer in charge. It is contractor's responsibilities to maintain barricades in order & safe guard from damage & thefts.

The measurement shall be for each piece and payment for each piece for providing and maintenance at site as per the direction of the engineer.

***Item No: 1.06 Provision of metal drum/empty bitumen drum******1.04 P Provision of metal drum/empty bitumen drum delineator, 300 mm in diameter, 800 mm high, filled with earth for stability, painted in circumferential strips of alternate black and white 100 mm wide fitted with reflectors 3 Nos of 7.5 cm dia, all as per IRC:SP:55-2001.***

The drums shall be of size 300mm in dia., 800mm height. They shall be constructed of lightweight, flexible and deformable material of plastic so that no damage is caused to the vehicle when stuck. Steel drums shall not be used. They may be of bright red, yellow or white colors. They should be portable enough to be shifted from place to place within a temporary traffic control project to accommodate changing conditions but would remain in place for a prolonged period. The markings on drums shall be horizontal, circumferential, alternative orange and white retro – reflective strips 100 mm wide . Each drum shall have a minimum of two orange and white strips.

Any non- retro reflective spaces between the horizontal orange and white strips shall not exceed 50mm wide. Drums shall have closed tops that will not allow collection of roadwork or other debris. When they are used in regions susceptible to freezing, they should have drainage holes in the bottom so that water will not accumulate and freeze, causing a hazard if struck by a motorist. Ballast shall not be placed on top of drum.

The measurement shall be for each piece and payment for each piece for providing and maintenance at site as per the direction of the engineer.

***Item No: 1.07 Rolling and compaction of Subgrade******1.07 Rolling and compaction of excavated surface and/or filled surface of subgrade with watering if required including filling in depression which occur during the process, with vibratory roller 8-10 T capacity until subgrade achieve required FDD.*****1.07.1 Compaction**

Compaction is carried out in two stages:

- a) An initial rolling and trimming which may be carried out followed by a final mixing pass of the rotavator.
- b) Final mixing, leveling and compaction between one and seven days after the initial mixing of Soil-lime-fly ash are beneficial. This time gap allows for the reactions between the lime and clay to take place and thus provide a more workable soil.

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### 1.07.2 Curing

Proper curing is very important for three reasons:

1. It ensures that sufficient water is retained in the layer so that the hydration reactions between the stabilizer, water and the soil can continue
2. It reduces shrinkage, and
3. It reduces the risk of carbonation from the top layer.

In temperate climate curing presents few problems. It is usually carried out by sealing the compacted surface to prevent escape of water during the curing period (usually seven days) during which time all construction traffic must be kept off the stabilized material. Before spraying is started the surface should be swept free of loose material and any damp areas should be free of standing water. The following methods of curing are suggested:

- i. Covering with an impermeable sheeting with joints overlapping at least 300 mm and set to prevent ingress of water.
- ii. Spraying with a bituminous sealing compound.
- iii. spraying with a resin based aluminous curing compound similar to those used for concrete. This has particular application where it is desirable to reduce the increase in temperature immediately under the surface which would result from the use of a black (bituminous) seal.

In a hot dry climate, the need for good curing is most important but the prevention of moisture loss is very difficult. If the surface is constantly sprayed and kept damp day and night the moisture content in the main portion of the layer will remain stable but the operation is likely to leach stabilizer from the top portion of the layer. If the spraying operation is intermittent and the surface dries from time to time (a common occurrence if this method is used) the curing will be completely ineffective.

Curing through spraying water can be much more efficient if a layer of sand 30 mm to 40 mm thick is first spread on top of the layer. In this case, the number of spraying cycles per day can be very much less and there is a considerable saving in the amount of water used.

When the stabilized layer is to be covered by other pavement layers the construction of the upper sections will provide a very good curing seal but care has to be taken to ensure that this work does not damage the top of the stabilized layer. During the period of time prior to the construction of the next layer some system of curing is required because, this is the most critical period in terms of shrinkage in the layer.

Primer can also serve as a curing membrane but, results have shown that a prime coat breaks down when it penetrates into the surface and completely loses any ability to seal it. A portion of any curing membrane must sit on the surface to achieve an effective seal if the top of the stabilized layer is sprayed lightly with water followed by an application of a viscous cutback bitumen, the loss of moisture is effectively reduced to zero. Similarly, the top of the stabilized layer can be sprayed with an emulsion to achieve the same result. It is essential, however, that all traffic is kept off the curing membrane for several days at which time excess bitumen can be absorbed by the surface.

### 1.07.3 Surface Finish and Quality Control of Work

**1.07.3.1 General**

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

**1.07.3.2 Horizontal Alignment**

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The corresponding tolerance for edges of the roadway and Subgrade layers of pavement shall be  $\pm 25$  mm.

**1.07.3.3 Surface Levels**

The levels of the subgrade shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 20$  mm.

For checking compliance with the above requirement for subgrade, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

**1.07.3.4 Surface Regularity of Pavement Courses**

The longitudinal profile shall be checked with a 3-meter-long straight edge/moving straight edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per 4.

Table 4 Maximum Permitted Number of Surface Irregularities

Irregularity	Surfaces of carriageways and Paved shoulder				Surfaces of Lay by, Service areas and all Bituminous Base courses			
	4 mm		7 mm		4 mm		7 mm	
Length	300	75	300	75	300	75	300	75
<b>Number of Surface Irregularities on Roads of all Category<sup>1</sup></b>	40	18	4	2	60	27	6	3

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 15 mm for Subgrade.

**1.07.3.5 Rectification**

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 4, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction

<sup>1</sup> Category of each section of road as described in the Contract

and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 305.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

#### **1.07.4 Strength**

When lime- fly ash is used for improving the subgrade, the soil-lime-fly ash mix shall be tested for its soaked CBR value. In case of variation from the design soaked CBR of 8%, in situ value being lower, the pavement design shall be reviewed based on the actual soaked CBR values. The extra pavement thickness needed on account of lower soaked CBR value shall be constructed by the Contractor at his own cost.

#### **1.07.5 Arrangements for Traffic**

##### **1.07.5.1 General**

The Contractor shall at all times, carry out work on the roadway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same, For all works involving improvements to the existing roadway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed close to the roadway, Before taking up any construction or maintenance operation, the Contractor shall prepare a Traffic Management Plan for each work zone and submit it to the Engineer for prior approval, if required. This plan should include following:

- i. Provision of a qualified safety officer with support staff to serve as a site safety team, as directed by Engineer.
- ii. Provision of traffic safety devices and road signs in construction zones as per IRC: SP:55.
- iii. Safety measures for the workers engaged including personal protection equipment.
- iv. First aid and emergency response arrangements.

Details and drawings of arrangements in compliance with other sub-Sections of this Section.

##### **1.07.5.2 Passage of Traffic along a Part of the Existing Carriageway under Improvement**

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders may be provided on the side on which work is not in progress on receipt of requirement of Engineer. The treatment to the shoulder shall consist of providing at least 150 mm thick granular (Wet Mix Macadam/Water Bound Macadam) base course covered with bituminous surface dressing in a width of at least 1.5 m and the treated shoulder shall be maintained throughout the period during which traffic uses the same, The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place, However, where work can be allowed in longer stretches by engineer looking to the site condition.

In case of eccentric widening of existing two-lane to four-lane, the additional two-lanes would be constructed first and the traffic diverted to it and only thereafter the

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required treatment to the existing carriageway would be carried out. In case of concentric widening, stipulations as in paragraph above shall apply.

After the works are completed, the treated shoulder shall be dismantled, the debris disposed of and the area cleared.

#### **1.07.5.3 Traffic Safety and Control**

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per the traffic management plan submitted by the Contractor, referred to in Clause 112.

All construction equipment shall be equipped with flashing yellow beacons.

The Contractor shall conduct all operations to minimize any drop-offs (abrupt changes in roadway) exposed to traffic. Drop-offs in the travelled way shall be protected by a wedge of compacted stable material capable of carrying traffic (the wedge being 1 vertical to 4 horizontal or flatter).

The Engineer shall authorize other methods, to protect drop-offs when conditions do not allow a wedge of compacted, stable material.

Warning signs, barricades, warning lights, and all other traffic control devices shall not be removed if the hazard has not been eliminated. Only upon receipt of specific written authorization from the Engineer, the Contractor may remove or cease to maintain warning signs, barricades, warning lights, and all other traffic control devices.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device. At night, the passage shall be delineated with lanterns or other suitable light source including solar energy bulbs.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflective type, as directed by the Engineer.

**1.07.5.4 Maintenance of Diversions and Traffic Control Devices**

Signs, lights, barriers and other traffic control devices, adequate lighting and other arrangements, as well as the riding surface of diversions and treated shoulders shall be maintained in a satisfactory condition till such time they are required and as directed by the Engineer.

**1.07.6 Measurements for Payment**

Stabilised soil diameter shall be measured as finished work in position in Square metres.No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**1.07.7 Rate**

The Contract unit rate for lime stabilised soil shall be payment in full for carrying out the required operations including full compensation for:

- (i) making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- (iv) carrying out the work in part widths of road where directed; and
- (v) carrying out the required tests for quality control.

***Item no. 1.08 Topographic Survey***

***Carrying out Topographic survey in full width of road showing location of inlet chamber, machinehole of strom line & drainage line with total station instrument etc. on existing road along with level survey of road for road profile at minimum 15 mt. class interval with chainage markings on site including C-Section, L-Section & centre line marking of roads as per instruction of engineer in charge.***

The measurement shall be for each KM and payment for each KM for providing and maintenance at site as per the direction of the engineer.

**Section: 2Milling Work*****Item No: 2.01 Milling the existing bituminous pavement up to a depth of 50 mm***

***2.01 Milling the existing bituminous pavement up to a depth of 50 mm by milling machine in a single cutting depth, to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete.***

Measurement for this Item will be in Sq m. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sq m.

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***Item No: 2.02 Milling the existing bituminous pavement for a depth more than 50 mm but up to 100 mm***

***2.02 Milling the existing bituminous pavement for a depth more than 50 mm but up to 100 mm by milling machine in a single cutting depth to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete.***

Measurement for this Item will be in Sq m. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sq m.

***Item No: 2.03 Milling the existing bituminous pavement for a depth more than 100 mm but up to 200 mm***

***2.03 Milling the existing bituminous pavement for a depth more than 100 mm but up to 200 mm by milling machine in double cutting depth to make a uniform surface without disturbing the base including diversion of traffic, removing milled materials and disposal of milled material to an approved dumping yard (within 12 km lead) including loading and unloading, all leads and lift, fuel, lubricant charges etc complete.***

Measurement for this Item will be in Sqm. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

## **Section: 3 Earth Work**

***Item No: 3.01 Earth work in excavation***

***3.01 Earth work in excavation in all types of strata other than rock for drains and channels etc., including dressing of bottom and sides of trenches, stacking the excavated spoil, clear from the edge of excavation including backfilling & disposal of surplus spoil as directed by the Engineer with all leads and lifts etc. complete.***

**3.01.1 EXCAVATION FOR ROADWAY AND DRAINS****Scope**

Insert the following between the words “roadway” and “side” in the second line: “road shoulders, verge, medians”.

**3.01.2 Disposal of Excavated Materials**

Delete this sub-clause and replace with ”All the surplus excavated materials shall be the property of the contractor. Suitable material obtained from the excavation of the roadway, shoulders, verge, drains, cross drainage works etc shall be used for

- i) Filling for roadway embankments.
- ii) Filling existing pits in the right of way as directed by the Engineer including leveling and spreading with all leads and lifts.
- iii) For landscaping of the road as directed by the Engineer, including leveling and spreading, with all leads and lifts.
- iv) Surplus material such as rubble, stones etc not intended for use as above shall be used as a raw material with prior permission of Engineer in charge.

Unsuitable and surplus material, which in the opinion of the Engineer cannot be used in the works, shall be removed from site by the Contractor and disposed off. including all

lead & lifts. No place will be made available by the employer for disposing off the material and no claim will be entertained on that account.

**3.01.3** Read item (i) of last Para as ‘loosening, excavating and recompacting the loosened material at sub-grade.

Point (v) as disposal of surplus material as directed with all leads and lifts.

### **3.01.4 Rates**

**3.01.4.1** Add the following after item (vi)

**(Modification)** In item (ii) replace “1000m” with “all leads & lifts”.

“(vii) The removal from site and disposal of all surplus or unsuitable materials obtained from excavation operations, which, in the opinion of the Engineer cannot be used in the works shall be included in the Contract rate”

**3.01.4.2** Replace the clause by “The loosening & recompaction of loosened material

**(Modification)** at sub grade is incidental to the work & no separate payment shall be made for this item.

**3.01.4.3** “all lifts & leads” instead of 1000 m lead.

**(Modification)**

### **3.01.5 EXCAVATION FOR STRUCTURES**

#### **3.01.5.1 Preparation of Foundation**

**(Modification)** In para 2 and 3 of clause 304.3.4 substitute concrete M-10 in place of 1:3:6 nominal mix.

**3.01.5.2** Replace 1000m with “all leads & lifts” in item(v).

**3.01.5.3** Replace 1000m with “all leads and lifts” in last line.

#### **3.01.5.4 Measurements for Payment**

Measurement for this Item will be in Cum.No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

## **Section: 4 Earthwork In Filling**

### ***Item No: 4.01 Earth work in embankment for subgrade and shoulders***

***4.01 Earth work in embankment for subgrade and shoulders by using mechanical means with approved material AS HARD MURRUM / QUARRY SPOIL having 4 days soaked CBR equal to or more than 12.5%, laying in layers not exceeding 250 mm loose, breaking clods, dressing to the required lines, curves, grades, watering to OMC and compacting to 97% modified Proctor density with vibratory rollers having minimum 80 - 100 KN static weight including all leads and lifts etc. complete.***

Refer to Clause 301 as stated above.

The subgrade shall conform to the grades and cross sections shown on the drawings and shall be uniformly compacted to the design strength in accordance with these

Specifications and Specification stipulated in the Contract. Subgrade material should be of Murrum type in general having CBR value of minimum 12.5% and Plasticity Index not exceeding 14%. Thickness of the Subgrade should be as indicated in the drawing. Compacted thickness of each layer of Subgrade shall not exceed 200mm and degree of compaction shall not be less than 97%. The lean concrete subbase shall not be laid on a subgrade softened by rain after its final preparation; surface trenches and soft spots, if any, must be properly back-filled and compacted to avoid any weak or soft spot. As far as possible, the construction traffic shall be avoided on the prepared subgrade. A day before placing of the sub-base, the subgrade surface shall be given a fine spray of water and rolled with one or two passes of a smooth wheeled roller after a lapse of 2-3 hours in order to stabilise loose surface. If Engineer feels it necessary, another fine spray of water may be applied just before placing sub-base

Immediately following the spreading of the subgrade material rolling shall be started with static / tandem roller of 8 T. capacity. Except on super elevated portion where the rolling shall proceed from inner edge to outer, rolling, shall be from the edges gradually progressing towards the center. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the center line of the road, in successive passes uniformly lapping preceding tracks by at least one half way width.

Rolling shall continue until the sub-grade material is thoroughly keyed and the creeping of the sub-grade ahead of the roller is no longer visible. During the process rolling shall not be done when the sub grade is soft or yielding or when it causes a wave like motion in the subgrade course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of sub grade material and re rolling until, the entire surface conforms to desired camber and grade. In no case shall use of screening be permitted to make up depressions.

The blindage materials where it is required to be used shall be applied, successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be continuously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding materials sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

After the final compaction of sub grade course, the road shall be allowed to dry overnight. Next morning hungry spot shall be filled with screening of binding materials as directed, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed on the road until the base has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed subgrade course if in his opinion it would cause excessive damage to the surface.

#### **MODE OF PAYMENT:**

Payment will be made on Cu.mt. basis consolidation of finished work and shall also include cost of watering, rent of machinery, cost of fuel, wages of drivers and cleaners, earthen and murrum bund etc. and watchman etc. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

***Item no. 4.02 Providing and filling yellow soil***

***4.02 Providing and filling yellow soil with necessary dumping filling of the trenches of each layer not exceeding 150 mm depth of including watering, ramming, consolidation, labour charge & tests required to be carried out etc. Complete.***

PART 1 - When excavated material is to be used, only selected stuff got approved from the Engineer-in-charge shall be used.

PART 2 - Soil specification should be as per BOQ and for embankment detail refer MORTH clause 305 section 300

**(i) Earthworks: General**

Earthworks shall involve the grading of soil for earth mounds, the excavation of trenches and soil for forming levels of pathways and foundations, and the fine grading of earth banks and horticulture areas.

The stripping and replacement of the subsoil shall only be done in dry weather and ground conditions unless in exceptional circumstances if the Landscape Architect/horticulture expert authorizes otherwise. Subsoil in heaps or dumps shall not be sited so as to damage or impede water courses or other drainage. Any weeds which may grow on the heaps of subsoil shall be sprayed with an approved selective weed-killer to prevent seeding

Notwithstanding the general description for the type of material to be excavated, if original bed rock is encountered during these operations which can only be removed by blasting or compressed air tools this work will be paid for separately as an extra over item for that given for normal excavation. This work shall only be undertaken when authorized in writing by the Landscape Architect/horticulture expert.

During excavation it is expected that the Contractor will take every prudent step or precautions such as tests or borings in order to prove the nature or type of material underneath or the ground bearing capacity in order to protect his workmen, plant or machinery employed in these operations.

In the event of the Contractor excavating below the proper levels or otherwise in excess of the dimension given, he shall at his own expenses, remove all loose excavated material and replace the soil excavated in error.

If, in the opinion of the Landscape Architect/horticulture expert the bottoms of any excavation or any material to be excavated become unsuitable due to the Contractor's operations, the Contractor shall, at his own expenses, carry out any necessary excavation and make up in a similar manner to the above.

If, in the opinion of the Landscape Architect/horticulture expert the weather conditions are such as to preclude the satisfactory completion of any operation or cause unnecessary nuisance or disturbance to other parties, the Contractor shall, on receiving directions from the Landscape Architect/horticulture expert suspend operations on that particular portion of the work until the Landscape Architect/horticulture expert considers that weather conditions are satisfactory, or issues a direction to re-commence operations. The absence

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of such a direction shall in no way constitute the basis of a claim for delay or remedial work to a formation which is unsuitable.

**b) Grading**

Grading involves the forming of earth mounds / hillocks from imported fill materials where specified, or from the soil generated by excavations. The soil shall be graded using suitable earth moving machinery to the contoured earth forms indicated on the drawings. Soil, when in a dry enough state for easy working, shall be distributed to the correct areas and laid in layers not exceeding 100mm thick and compacted by at least 2 passes of the earth moving machine in each direction for each 100mm layer.

Earth slopes are to be formed from the compacted mounds to the gradients and levels shown on the drawings, accounting for the topsoil depths to be included after subsoil formation is complete. If insufficient fill is available to complete the levels shown, additional suitable subsoil is to be imported to make up the required quantities. Importation of additional fill shall only be carried out with written permission of the Landscape Architect/horticulture expert.

Earthworks levels are to be carried out to the contours shown on the drawings to a maximum tolerance of 150mm measured vertically, and to a maximum gradient as permissible based on soil testing. If the gradient exceeds the permissible gradient of soil type, a geotextile membrane should be used to hold the soil. All subsoil levels are to account for the later additional of specified depths of topsoil.

The Contractor shall be responsible for protection of completed subsoil mounds and shall take preventative measures to control erosion and siltation, restore or replace any portion of the earthwork areas which erodes, slumps, silts or is otherwise damaged by the out-washing of soil.

**Excavation for forming Levels and Trenches**

Firmly compact sub-grade with a smooth wheeled vibratory roller to achieve an even level. Finished sub-grade is to be protected until the path sub-base or other construction such as pool sub-base is laid. If sub-grade is too dry to be compacted, water shall be added until suitable texture is achieved. If sub-grade is too wet, the material shall be left to dry out until workable.

A completed sub-grade/formation on which there is standing water, soft spots or slurry shall be deemed to be unsuitable and shall be rectified at the Contractor's expense including making up of additional material as required to bring the formation to line and level again.

Where soft or wet ground is encountered prior to preparation of the sub-grade and this soft or wet ground cannot satisfactorily be compacted, the Contractor shall submit a written request for this to be inspected and the area to be dug out and replaced with suitable material shall be evaluated by the Landscape Architect/horticulture expert and directed accordingly.

Surplus material resulting from excavations for path formation or drainage trenches shall be taken off site at Contractor's own expense unless otherwise directed by the Landscape Architect/horticulture expert in writing.

**Fine Grading and Shaping**

Fine grading shall be carried out using small sized earth moving equipment or by hand, and shall involve final modelling of the earth contours produced by the major grading exercise. The shaping will follow the contours shown on the plans in general terms, but the final forms

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will be developed by eye to create smoothly flowing and pleasing contours. Mounds to have distinct concave slope transitions at the foot of slopes, and convex slope transitions at the top of slopes. Maximum gradient to be as permissible based on soil testing. If the gradient exceeds the permissible gradient of soil type, a geotextile membrane should be used to hold the soil. The Fine Grading will provide the detailed earth contouring prior to cultivation of soil. Soil cultivation and the application of topsoil mixes shall not take place until the Fine Grading is completed.

## **Soils and Ameliorants**

### **Subsoil**

Subsoil shall be a free draining soil, generally from horizon over 300mm below the original surface to be used as fill materials, either excavated from areas of the site, or imported.

### **Topsoil Mixes**

The components of the Topsoil Mixes shall be as follows:

Topsoil shall be a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 15% by volume.

### **TOP SOIL SPECIFICATION:**

The following criteria shall be tested at an approved laboratory before use on site.

pH 5.5 - 7.8

Electrical conductivity 1:2.5 (w/v)

Soil-water extracts not exceeding 1500 micromho/cm (1500 micro-Siemens/ cm)

### **Soil texture:**

Sand (0.05 - 2.00mm)

Silt (0.002 - 0.05mm)

Clay (less than 0.002mm)

Max. 75% Min. 20%

Max. 60% Min. 5%

Max. 30% Min. 5%

Soil Conditioner shall be dried treated sludge, organic compost or other fibrous approved organic matter suitable for mixing with topsoil to make a friable growing medium for plants, resistant to rapid decay, free of soluble salts below 900ppm, pH 6-7, free of large lumps or debris.

Organic Compost shall be organic vegetable compost produced by a thorough horticultural or industrial composting process or Farm Yard Manure (Cow Dung Manure). Compost is to have a clean, un-decomposed smell free from any rotting substances, debris, refuse, clay or visible fungus. A sample is to be submitted for approval before usage. All composts are to be sterilized before being packed for transport and odorous materials used on site will be rejected. Any vermin resulting from use of organic composts will have to be controlled by the Contractor within 12 hours of any infestation.

Sand shall be a clean, coarse grained and angular material sourced from a river bed with a minimum 1mm diameter section. It shall be well graded, free from soluble salts

ranging in size so that 80-100% passes the 3mm sieve and 0-50% passes the 2mm sieve, with 0% passing through a 1mm sieve.

Lightweight Aggregate shall be an approved low density inert material such as expanded shale or clay or volcanic scoria or other porous aggregate capable of being compacted within the soil zone to 90% compaction without being crushed, free from dust and debris, pH 6-6.5, free of soluble salts. A 2 liters' sample shall be submitted and tested as part of the soil mix for physical and chemical performance. Materials are to be approved in writing before installation.

### Soil Mixes

The following soil mixes are to be used for different areas and for different types of planting. Minor changes to the proportions shown for particular species may be required, as specified by the Landscape Architect/horticulture expert from time to time.

Soil Mix A: for use in natural ground level areas shall comprise the components listed below, which shall be mechanically cultivated to the correct proportions, prior to placement on site or back-filling. Soil Mix A shall comprise the following proportions by volume:

Topsoil	50%
Sand	20%
Soil Conditioner	15%
Organic Compost	15%

### Soil Preparation and Application of Soil Mixes

All subsoil areas to be top-soiled shall be cleaned free of rubbish, weeds, all stones exceeding 50mm in diameter and builders debris shall be removed from site. Any areas which are contaminated by petrol, soil or other toxic substances shall be excavated to 300mm below the contamination and have the excavated material removed from site. The excavated areas shall be back filled with imported topsoil as specified. These operations shall take place immediately before top-soiling (with soil mixes) commences.

Where directed by the Landscape Architect/horticulture expert, the ground shall be de-compacted by ripping to a depth of 300mm. All obstructions to cultivation or deleterious material brought to the surface shall be removed from the site and any voids left by this operation shall be back-filled with imported subsoil as specified.

Subsoil shall be formed to the finished levels and contours after settlement and with overall even compaction.

No topsoil or soil mixes shall be spread, or cultivation carried out until the subsoil operations have been approved by the Landscape Architect/horticulture expert.

Topsoil or soil mixes shall be spread on the designated areas to the depth shown on the drawings. The loose depth of the topsoil shall be sufficient to allow the area to conform to the levels shown on drawings after natural settlement has taken place. Soil Mixes shall not be compressed or rolled to achieve levels. Conversely if levels drop below specified levels, additional soil mixes are to be added to achieve levels.

Soil Mixes are to be carefully spread by machine or hand in a moist condition. Very wet or dry soil mixes must not be used. Heavy compaction of soil mixes is to be prevented and compacted soil will be rejected. Soil Mixes are to be spread to the following minimum depths in open ground areas:

Unless directed otherwise or as shown on the drawings

When in the opinion of the Landscape Architect/horticulture expert site conditions are unsuitable for working, soiling operations shall cease and shall only be resumed when authorized by him.

Contractor shall be responsible for soil protection and shall take preventative measures to control erosion and siltation of all areas and shall restore or replace any portion of the site which erodes, silts up or is otherwise damaged by out-washing of soil.

No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

## **Section: 5 Flexible Pavement**

### ***Box cutting***

***Box cutting the road surface to proper slope and camber for road work including a base for road work including removing the excavated stuff depositing on the road side slope as directed up to 50.0 mt. Lead.***

### **Description**

The land width required for the roadway, gutters side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cm. and less, loose stones, vegetation bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cm. below the grade formation and slopes and excavation filled up with excavated materials and loose. Useful materials shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 meters lead, and handed over to the department in convenient sections. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works, property or people in the neighborhood. If the materials disposed off outside the road land, necessary permission from the private land owners shall be taken by the contractor and royalty etc. if any paid by him without claiming any compensation. All materials shall be disposed off in a neat manner.

After cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes, grade and sections as shown on the plans or directed by the Engineer. The Contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out establishing bench marks and giving profiles. The Contractor shall be responsible for maintaining the B.M. profiles, alignments and other marks as long as they are required for the work in the opinion of the Engineer. If the Contractor defaults in the respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the cost of Contractor. Levels and section of the ground shall be taken and recorded in the presence of the Contractor or his authorized representative before the excavation is started so as to serve as the basis of

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measurement. The Contractor or his representative shall sign the book in token of his acceptance of the level etc. If there is any disagreement the Contractor shall inform of it in writing to the Engineer with the specified reference to the sections before starting further work. Once the work is started no cognizance of any complaint shall be taken merely not signing of the book shall not be deemed as disagreement.

Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10m to 50m or other intervals as directed by the Engineer to conform to the curved or straight alignment, section, grade and side slopes. The line outs shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side or each lift and the sides slopes for that shall be excavated in steps. These steps shall be smoothed to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specific grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layer watered and fully loose to attain maximum density laid down for the embankment in its relevant item. The Engineer may require measurement ridges and deadmen to be left at specified intervals or places and kept intact till ordered to be removed, for the purposes of check measurements. The excavation shall be finished neatly, smoothly and evenly to the correct lines, curves, grades, section and side slopes as shown on the plans or directed by the Engineer. The diameter if loose, shall be scarified, watered and loose to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be well drained by providing necessary diversion etc. and not damaged due to obstruction of any drainage, necessary passages shall be provided leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The Contractor at his own cost shall make good the interrupted drainage and sewer etc. unless separately provided in the tender. Any damage to the existing works or work in hand caused as a result of his operations or negligence shall be made good by the Contractor at his own cost. Road side gutters shall be excavated to the specified section and shall be measured along with the main cutting in cubic meters.

Signallers shall be stationed at each end to regulate traffic where it is heavy, If necessary. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc. due to the negligence of the Contractor, he will be responsible and liable to all the consequence including compensation. When the useful excavated materials are to be used in embankment within a lead 50 meter and all lift, it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials are temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations should be arranged properly,

Materials required for items other than bank shall be arranged in neat stacks at convenient places, without interfering with drainage in any way. The excavated materials shall not be deposited within 3 mt. from the top edge of slope or top of the bank. The lead shall be measured from the junction point of cutting and embankment up to 50 mt. on either side. The contract rate shall be for a unit of one cubic meter for the stratus mentioned in the wording of the item of excavation acceptably completed, as directed by the Engineer.

### **Disposal of excavated materials**

All the surplus excavated materials shall be the property of the contractor. Suitable material obtained from the excavation of the roadway shoulders, verge, drains, cross drainage works etc. shall be used for

- i. Filling for roadway embankments
- ii. Filling existing pits in the right of way as directed by the Engineer including leveling and spreading with all leads and lifts.
- iii. For landscaping of the road as directed by the Engineer, including leveling and spreading, with all leads and lifts.
- iv. Surplus material such as rubble, stones etc. not intended for use as above shall be used as a raw material for crusher with prior permission of Engineer.

Unsuitable and surplus material which in the opinion of the Engineer cannot be used in the works shall be removed from site by the Contractor and disposed off including all lead & lifts. No place will be made available by the employer for disposing off the material and no claim will be entertained on that account.

### **Measurements for payment**

Excavation for roadway shall be measured by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in cu. m. by the method of average end areas for each class of material encountered. At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### **Rates**

The contract unit rates for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for:

- i. Setting out
- ii. Transporting the excavated materials and depositing the same on sites of embankments, spoil banks or stacking as directed within lifts and lead up to 50m.
- iii. Trimming bottoms and slopes of excavation
- iv. Dewatering
- v. Disposal of surplus excavated stuff and clearing of site after completion of work.
- vi. Watering where necessary and compacting to requirements.
- vii. Erecting all safety provisions and making necessary diversions as directed by Engineer of concerned zone.

***Item no: 5.01 Excavation by means of Disc harrow or Rotavator***

***5.01 Excavation of the soil by means of Disc Harrowing or Rotavator, as the case may be, upto 240 mm depth for full width of road and breaking the soil into pieces less than 20 mm etc.by the use of Rotavator and as directed by engineer in charge. (200 mm compacted thickness)***

**Description**

The work includes excavation for the specified depth with ploughing with Disk harrow or Rotavator as directed by Engineer to proper slope, line and length. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 300 mm and less, loose stones, vegetation, bushes stamps and all other objectionable materials. All the materials cleared will be the property of Surat Municipal Corporation. Useful materials shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 meters lead and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, in convenience or damage to the works, Property or people in the neighborhood. After working with plough the fraction of the soil having more than 25 mm lumps, will be crushed/broken to finer size. If ploughing is used longitudinal and transverse travel has to be completed to satisfaction of Engineer. Watering is not permitted.

For fly ash-soil stabilization, the soil before addition of stabilizer shall be pulverized to that extent that of least 80% through 4.75 mm sieve.

It is mandatory to excavate with rotavator for all categories of road except Residential roads where Disk Harrow shall be used for excavation.

***Item no: 5.02 Supplying fly ash including collecting, carting and stacking and spreading***

***5.02 Supplying Fly ash including collecting, carting, stacking and spreading the same as directed.***

Table 1 Chemical Requirements for Fly Ash as Pozzolana (Table No.3-IRC:SP:89-2010)

Sr. No.	Characteristics	Requirements for fly Ash		Method of test
		Anthracitic fly ash	Lignitic fly ash	
1.	SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> in percent by mass, Min	70	50	IS:1727
2.	SiO <sub>2</sub> in percent by mass, Min	35	25	IS:1727
3.	MgO in percent by mass, Max	25	5.0	IS:1727
4.	SO <sub>3</sub> in percent by mass, Max	2.75	3.5	IS:1727
5.	Available alkalies as Na <sub>2</sub> O/K <sub>2</sub> O in percent by mass, Max	1.5	1.5	IS:4032
6.	Total chlorides in percent by mass, Max	0.05	0.05	IS:1727

7.	Loss on ignition in percent by mass, Max	5.0	5.0	IS:1727
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Limits regarding moisture content of fly ash shall be as agreed to between the purchaser and the supplier. All tests for the properties specified in above table shall, however, be carried out on oven dry samples.

**Table 2 Physical Requirement for Fly Ash as a Pozzolona (Table No.4-IRC:SP:89-2010)**

Sr.No.	Characteristics	Requirement
1.	Fineness-specific surface in m <sup>2</sup> /Kg by Blaine's permeability test, Min	250
2.	Particles retained on 45 micron IS sieve, Max	40
3.	Lime reactivity in N/mm <sup>2</sup> , Min	3.5
4.	Soundness by autoclave test expansion of specimen in percent, Max	0.8
5.	Soundness by Le-chatelier method-expansion in mm, Max	10

### Spreading of fly ash

Quantity of fly ash to be added with soil at rate of **50 kg per Square Meter** area of soil. Spreading the stabilizer at the required dosage rate can be carried out manually. For manual method for spreading stabilizer bags of stabilizer are spotted at a set spacing, they are then broken open and the stabilizer raked across the surface as uniformly as possible. Standard weight of bag containing fly ash should be 50 kg.

### Measurements for Payment

The fly ash shall be measured in terms of M.T. weight and corresponding gate passes of each load issued from SMC Weigh Bridge shall be submitted. The payment for the fly ash quantity shall be done accordingly. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### Rate

The contract unit rates consist of the following:

1. Collecting the fly ash of required gradation from the source.
2. Carting of the fly ash to the construction site.
3. Weighing the same at SMC weigh Bridge / approved weigh bridge with prior permission of Engineer.
4. Stacking the fly ash in required quantity as directed by Engineer.
5. Spreading the fly ash evenly at a rate of **50 kg/SM** as directed by Engineer.

***Item no: 5.03 Supplying and carting of Hydrated lime and spreading the same***  
***5.03 Supplying and carting of Hydrated lime (CaO content not less than 70%) and spreading the same with the excavated soil and flyash thoroughly by Disc Harrowing or Rotavator, as the case may be, including watering etc. complete as directed by engineer in charge.***

Lime for lime-soil stabilization work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. The lime shall have purity of not less than 70 percent by weight of Quick-lime (CaO) when tested in accordance with IS:1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

Lime for stabilization shall confirm the requirements of class C hydrated lime, which should have at least 95%, 99% and 100% passing through 0.212mm, 0.300 mm and 0.850 mm respectively.

### **Spreading the Hydrated Lime**

Quantity of lime to be added with soil at rate of **10 kg per Square Meter** area of soil.

Spreading the stabilizer at the required dosage rate can be carried out manually. For manual method for spreading stabilizer bags of stabilizer are spotted at a set spacing, they are then broken open and the stabilizer raked across the surface as uniformly as possible. Standard weight of bag containing hydrated lime should be 50 kg.

Lime has a much lower bulk density than cement and it is possible, therefore, to achieve a more uniform distribution with lime when stabilizers are spread manually. The uniformity of the layer of stabilizer spread over the surface, before the mixing operation, determines the uniformity of the mixed material produced.

### **Mixing lime and Fly ash with soil particles**

Mixing lime and fly ash thoroughly with soil particles by means of rotavator and quantity of water as per OMC to be achieved from soil tests. Robust mixing equipment of suitable power for the layer being processed is required to pulverize the soil and blend it with the stabilizer and water. The most efficient of the machines available carry out the operation in one pass, enabling the layer to be compacted quickly and minimizing the loss of density and strength caused by any delay in compaction. Multi pass machines are satisfactory, provided the length of pavement being processed is not excessive and each section of pavement can be processed within an acceptable time.

The plasticity of the material is overriding factor in the ability of mixing plant to mix the soil with stabilizer. A review of work showed that all plastic soil could be satisfactorily mixed with cement using the plant. For cohesive soils a factor of the plasticity index of the soil multiplied by the percentage of the fraction of the soil which was finer than 425 micron in particle diameter may be used to suggest the values for the different types of mixing plant available, which are given in Table 3.

**Table 3 Soil Plasticity Limits for Stabilization Using Different Types of Plant (Table No.13-IRC:SP:89-2010)**

Type of Machinery <sup>2</sup>	Plasticity Index X Percentage of fraction finer than 425 micron	Normal maximum depth (mm) capable of being processed in one layer
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<sup>2</sup>Selection of the appropriate Machinery should be left to the decision of the Engineer.

Agricultural harrows, Disc rotavators, Disc ploughs,	Less than 1000	120-150
Light duty rotavators (< 100 hp)	Less than 2000	150
Heavy duty rotavators (> 100 hp)	Less than 3500	200-300 (depending on soil type and horsepower of mixer)

### **Addition of Water**

The water to be used for lime stabilization shall be clean and free from injurious substances. Potable water shall be used.

The moisture content at compaction checked vide IS:2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS:2720 (Part 8) nor more than 2 percent above it. If it is necessary to add water to bring the moisture content to the required value this can either be done as part of the mixing operation or after the material has been prepared prior to the addition of the stabilizer. To ensure a thorough distribution of the added water, it is preferable to add water as part of the mixing operation. Water added during the mixing process should be through a spray system such that it is added in a uniform manner over the required area and mixed uniformly to the required depth. Where the mixing plant does not enable water to be added or where it is not possible to add enough water during mixing it should be added to the prepared material using a spray system that enables the amount to be controlled over the whole area. The material to be stabilized should then be mixed prior to the addition of the stabilizer to ensure the distribution of the water throughout the layer.

### **Rate and mode of payment**

Payment will be made on M.T. basis, contractor has to weight the loaded and unloaded truck on any of the weigh bridge of Municipal Corporation. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### ***Item no: 5.04 Rolling and compaction of Subgrade***

***5.04 Rolling and compaction of Subgrade with 8 T. vibratory roller and filling in depressions which occur during the process as directed by engineer in charge.***

#### **Compaction**

Compaction is carried out in two stages:

- A. An initial rolling and trimming which may be carried out followed by a final mixing pass of the rotavator.
- B. Final mixing, leveling and compaction between one and seven days after the initial mixing of Soil-lime-fly ash are beneficial. This time gap allows for the reactions between the lime and clay to take place and thus provide a more workable soil.

#### **Curing**

Proper curing is very important for three reasons:

- It ensures that sufficient water is retained in the layer so that the hydration reactions between the stabilizer, water and the soil can continue
- It reduces shrinkage, and
- It reduces the risk of carbonation from the top layer.

In temperate climate curing presents few problems. It is usually carried out by sealing the compacted surface to prevent escape of water during the curing period (usually seven days) during which time all construction traffic must be kept off the stabilized material. Before spraying is started the surface should be swept free of loose material and any damp areas should be free of standing water. The following methods of curing are suggested:

- Covering with an impermeable sheeting with joints overlapping at least 300 mm and set to prevent ingress of water.
- Spraying with a bituminous sealing compound.
- spraying with a resin based aluminous curing compound similar to those used for concrete. This has particular application where it is desirable to reduce the increase in temperature immediately under the surface which would result from the use of a black (bituminous) seal.

In a hot dry climate, the need for good curing is most important but the prevention of moisture loss is very difficult. If the surface is constantly sprayed and kept damp day and night the moisture content in the main portion of the layer will remain stable but the operation is likely to leach stabilizer from the top portion of the layer. If the spraying operation is intermittent and the surface dries from time to time (a common occurrence if this method is used) the curing will be completely ineffective.

Curing through spraying water can be much more efficient if a layer of sand 30 mm to 40 mm thick is first spread on top of the layer. In this case, the number of spraying cycles per day can be very much less and there is a considerable saving in the amount of water used.

When the stabilized layer is to be covered by other pavement layers the construction of the upper sections will provide a very good curing seal but care has to be taken to ensure that this work does not damage the top of the stabilized layer. During the period of time prior to the construction of the next layer some system of curing is required because, this is the most critical period in terms of shrinkage in the layer.

Primer can also serve as a curing membrane but, results have shown that a prime coat breaks down when it penetrates into the surface and completely loses any ability to seal it. A portion of any curing membrane must sit on the surface to achieve an effective seal if the top of the stabilized layer is sprayed lightly with water followed by an application of a viscous cutback bitumen, the loss of moisture is effectively reduced to zero. Similarly, the top of the stabilized layer can be sprayed with an emulsion to achieve the same result. It is essential, however, that all traffic is kept off the curing membrane for several days at which time excess bitumen can be absorbed by the surface.

## **Surface Finish and Quality Control of Work**

### **General**

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

### Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The corresponding tolerance for edges of the roadway and Subgrade layers of pavement shall be  $\pm 25$  mm.

### Surface Levels

The levels of the subgrade shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 20$  mm.

For checking compliance with the above requirement for subgrade, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

### Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straight edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

**Table 4 Maximum Permitted Number of Surface Irregularities**

Irregularity	Surfaces of carriageways and Paved shoulder				Surfaces of Lay by, Service areas and all Bituminous Base courses			
	4 mm		7 mm		4 mm		7 mm	
Length	300	75	300	75	300	75	300	75
Number of Surface Irregularities on Roads of all Category <sup>3</sup>	40	18	4	2	60	27	6	3

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 15 mm for Subgrade.

### Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 305.

<sup>3</sup> Category of each section of road as described in the Contract

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Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision) reproduced in Chapter **Error! Reference source not found.**

### **Strength**

When lime- fly ash is used for improving the subgrade, the soil-lime-fly ash mix shall be tested for its soaked CBR value. In case of variation from the design soaked CBR of 8%, in situ value being lower, the pavement design shall be reviewed based on the actual soaked CBR values. The extra pavement thickness needed on account of lower soaked CBR value shall be constructed by the Contractor at his own cost.

### **Arrangements for Traffic**

#### **General**

The Contractor shall at all times, carry out work on the roadway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same, For all works involving improvements to the existing roadway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed close to the roadway, Before taking up any construction or maintenance operation, the Contractor shall prepare a Traffic Management Plan for each work zone and submit it to the Engineer for prior approval, if required. This plan should include following:

- i. Provision of a qualified safety officer with support staff to serve as a site safety team, as directed by Engineer.
- ii. Provision of traffic safety devices and road signs in construction zones as per IRC: SP:55.
- iii. Safety measures for the workers engaged including personal protection equipment.
- iv. First aid and emergency response arrangements.

Details and drawings of arrangements in compliance with other sub Sections of this Section.

#### **Passage of Traffic along a Part of the Existing Carriageway under Improvement**

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders may be provided on the side on which work is not in progress on receipt of requirement of Engineer. The treatment to the shoulder shall consist of providing at least 150 mm thick granular (Wet Mix Macadam/Water Bound Macadam) base course covered with bituminous surface dressing in a width of at least 1.5 m and the treated shoulder shall be maintained throughout the period during which traffic uses the same, The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place, However, where work can be allowed in longer stretches by engineer looking to the site condition.

In case of eccentric widening of existing two-lane to four-lane, the additional two-lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. In case of concentric widening, stipulations as in paragraph above shall apply.

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After the works are completed, the treated shoulder shall be dismantled, the debris disposed of and the area cleared.

### **Traffic Safety and Control**

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per the traffic management plan submitted by the Contractor, referred to in Clause 0.

All construction equipment shall be equipped with flashing yellow beacons.

The Contractor shall conduct all operations to minimize any drop-offs (abrupt changes in roadway) exposed to traffic. Drop-offs in the travelled way shall be protected by a wedge of compacted stable material capable of carrying traffic (the wedge being 1 vertical to 4 horizontal or flatter).

The Engineer shall authorize other methods, to protect drop-offs when conditions do not allow a wedge of compacted, stable material.

Warning signs, barricades, warning lights, and all other traffic control devices shall not be removed if the hazard has not been eliminated. Only upon receipt of specific written authorization from the Engineer, the Contractor may remove or cease to maintain warning signs, barricades, warning lights, and all other traffic control devices.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device. At night, the passage shall be delineated with lanterns or other suitable light source including solar energy bulbs.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflective type, as directed by the Engineer.

### **Maintenance of Diversions and Traffic Control Devices**

Signs, lights, barriers and other traffic control devices, adequate lighting and other arrangements, as well as the riding surface of diversions and treated shoulders shall be maintained in a satisfactory condition till such time they are required and as directed by the Engineer.

**Measurements for Payment and Rate**

Arrangements, as contained in MoRTH-2013 (Fifth Revision), Provision of treated shoulders for safety of road users during construction shall be measured and paid as per the BOQ. However, their maintenance, dismantling and cleaning debris shall be considered as incidental to the Works and shall not be paid separately. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Measurements for Payment**

Stabilized soil diameter shall be measured as finished work in position in cubic metres.

**Rate**

The Contract unit rate for lime stabilised soil shall be payment in full for carrying out the required operations including full compensation for:

- making arrangements for traffic to Clause 0 except for initial treatment to verges, shoulders and construction of diversions;
- supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- all labour, tools, equipment and incidentals to complete the work to the Specifications;
- carrying out the work in part widths of road where directed; and
- carrying out the required tests for quality control.

***Item no: 5.05 Providing and laying Granular Sub Base conforming to grading V***

***5.05 Providing and laying Granular Sub Base (drainage layer) conforming to grading V of Table 400-1 of compacted thickness of 150 mm with specified graded stone metal and sand mixed in pugmill and laid with mechanical means spreading with motor grader and compacting with vibratory roller having minimum 80-100 kN static weight to achieve desired density of 98% of MDD including all materials, labour, machinery with all leads and lifts etc., complete.***

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one layer as sub-base according to lines, grades and cross-sections shown on the drawings.

**Material requirements**

The material to be used for the work shall be natural sand, crushed gravel, crushed stone or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 5 and physical requirements given in Table 6. If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

**Table 5 Grading for Granular Sub-base (GSB-V) Materials**

IS size (mm)	Percent by Weight Passing the IS Sieve
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	(Grading-V)
75.0	100
53.0	80-100
26.5	55-90
9.50	35-65
4.75	25-50
2.36	10-20
0.85	2-10
0.425	0-5
0.075	-

**Table 6 Physical Requirements for Materials for Granular Sub-base**

Physical properties	Test procedure	Requirement
Aggregate Impact Value (%)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit (%)	IS:2720 (Part 5)	Maximum 25
Plasticity Index (%)	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS: 2720-Part 8) (%)	IS:2720 (Part 5)	Minimum 30

### Construction Operations

#### Preparation of diameter

Immediately prior to the laying of sub-base, the subgrade already finished as mentioned in ITEM NO. 5 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

#### Spreading and Compacting

The Granular sub-base material of the grading-V and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing so as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate, capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on superelevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

## **Surface Finish and Quality Control of Work**

### **General**

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

### **Horizontal Alignment**

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The tolerance for edges of the roadway and Sub-base layers of pavement shall be  $\pm 25$  mm.

### **Surface Levels**

The levels of the Granular sub-base shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 10$  mm.

For checking compliance with the above requirement for Granular sub-base, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

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**Surface Regularity of Pavement Courses**

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 8 mm for Granular Sub-base.

**Rectification**

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 401. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

**Arrangements for Traffic**

During the period of construction, arrangement for traffic shall be provided and maintained in accordance with Clause 0.

**Measurements for Payment**

Granular sub-base shall be measured as finished work in position in cubic meters. The protection of edges of granular sub-base extended over the full formation width shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Rate**

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- i. Making arrangements for traffic to Clause 0 except for initial treatment to verges, shoulders and construction of diversions.
- ii. Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts.
- iii. All labour, tools, equipment and incidentals to complete the work to the Specifications.
- iv. Carrying out the work in part widths of road where directed.
- v. Carrying out the required tests for quality control.

***Item no: 5.06 Providing and laying Wet Mix Macadam***

***5.06 Providing and laying Wet Mix Macadam with paver finisher in specified thickness, each layer not exceeding 100 mm compacted thickness including premixing in WMM plant***

*with well graded crushed stone aggregate, with watering and spreading by mechanical means to required profile and compacting by vibratory roller of minimum 80-100 kN static weight to achieve desired density of 98% of MDD including all material, labour, machinery with all leads and lifts etc.*

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared Granular sub- base or existing pavement as the case may be in accordance with the requirements of the specifications of Wet Mix Macadam for Base course. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings. The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm.

#### **Material requirements**

Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements set forth in Table 7.

If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

**Table 7 Physical Requirements of coarse Aggregates for Wet Mix Macadam**

<b>Test</b>	<b>Test Method</b>	<b>Requirements</b>
Los Angeles Abrasion value OR Aggregate Impact value	IS:2386 (Part-4)  IS:2386 (Part 4) or IS 6640	40 percent (Max.)  30 percent (Max.)
Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-I)	35 percent (Max.) <sup>4</sup>

**Table 8 Grading Requirements of Aggregates for Wet Mix Macadam**

<b>IS Sieve size (mm)</b>	<b>Percent by Weight passing the IS Sieve</b>
53.00	100
45.00	95-100
26.50	-

<sup>4</sup>To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

22.40	60-80
11.20	40-60
4.75	25-40
2.36	15-30
0.60	8-22
0.075	0-5

Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

### **Construction Operations**

#### **Preparation of Base**

The surface of the Granular sub-base to receive the Wet Mix Macadam course shall be prepared to the specified grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the WMM is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WMM.

#### **Provision of Lateral Confinement of Aggregates**

While constructing wet mix macadam (WMM), arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying soil having minimum 8% soaked CBR in adjoining shoulders along with that of wet mix macadam layer. The practice of constructing WMM in a trench section excavated in the finished formation must be completely avoided.

Where the WMM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders should be excavated to their full depth and width up to the diameter level except where widening specifications envisages laying of a stabilised sub-base using in-situ operations in which case the same should be removed only up to the sub-base level.

#### **Preparation of Mix**

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have following features:

- i. For feeding aggregates- three/ four bin feeders with variable speed motor
- ii. Vibrating screen for removal of oversize aggregates

- iii. Conveyor Belt
- iv. Controlled system for addition of water
- v. Forced/positive mixing arrangement like pug-mill or pan type mixer
- vi. Centralized control panel for sequential operation of various devices and precise process control
- vii. Safety devices

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. The mixed material should be uniformly wet and no segregation should be permitted.

### **Spreading of Mix**

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared Granular sub-base in required quantities. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted. The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i. Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- ii. Hydraulically operated telescopic screed for paving width up to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii. Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual laying in inaccessible remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual laying is intended to be used, the same shall be done with the approval of the Engineer.

### **Compaction**

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the diameter is soft or yielding or when it causes a wavelike motion in the sub-base/base course or diameter. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompact.

### **Setting and Drying**

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

### **Opening to Traffic**

No vehicular traffic shall be allowed on the finished wet mix macadam surface.

### **Surface Finish and Quality Control of Work**

#### **Horizontal Alignment**

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The tolerance for edges of the roadway and WMM layers of pavement shall be  $\pm 25$  mm.

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**Surface Levels**

The levels of the Base course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 10$  mm, in case of Machine laid mix and  $\pm 15$  mm, in case of Manually laid mix.

For checking compliance with the above requirement for Wet Mix Macadam, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

**Surface Evenness**

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 8 mm for Wet Mix Macadam.

**Quality Control**

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

**Rectification of Surface Irregularity**

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to diameter soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and re-compacted in accordance with Clause 0. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

**Arrangement for Traffic**

During the period of construction, arrangements for traffic shall be done as per Clause 0.

**Measurements for Payment**

Wet mix macadam shall be measured as finished work in position in cubic meters. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Rate**

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for:

- i. making arrangements for traffic to Clause except for initial treatment to verges, shoulders and construction of diversions;

- ii. supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. all labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv. carrying out the work in part widths of road where directed; and
- v. carrying out the required tests for quality control.

***Item no: 5.07 Supplying and applying Slow Setting-1 (SS-I)***

***5.07 Supplying and applying Slow Setting-1 (SS-I) bitumen emulsion confirming to IS 8887, for application of prime coat over Wet Mix Macadam at the rate of 0.85 kg per Sq.Meter area, including all materials, labour, machinery, test with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.***

Prime coat consists of the application of a single coat of bitumen emulsion to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared Wet Mix Macadam.

**Material**

The primer shall be cationic bitumen emulsion SS-1 grade conforming physical and chemical properties shown in Table 9. Quantity of SS-1 grade bitumen emulsion for Wet mix macadam shall be **0.85 kg/Sq.mt.** Quantity of Bitumen emulsion shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C.

**Table 9 Physical and Chemical properties of Bitumen Emulsion Grade SS-1**

Sr. No.	Properties	
1	Residue on 600 micron IS Sieve, percent by mass, (Max)	0.05
2	Viscosity by Saybolt Furol viscometer, seconds: At 25° C	20-100
3	Coagulation of emulsion at low temperature	Nil
4	Storage stability after 24 h, percent (Max)	2
5	Particle charge	Weak Positive
6	Stability to mixing with cement (percentage coagulation), Max	2
7	Tests on residue:	
	A. Residue by evaporation, percent, (Min)	50
	B. Penetration 25°C/100g/5 sec	60-350
	C. Ductility 27° C/cm, A4in	50

	D. Solubility: In trichloroethylene, percent by mass (Min)	98
8	Distillation in percent, by volume at	
	A. 190° C	20-55
	B. 225° C	30-75
	C. 260° C	40-90
	D. 315° C	60-100
9	Water content, percent by mass, (Max)	20

If Emulsion is stored for more than 90 days, its properties as mentioned in Table 9 should be checked apart from the frequency mentioned in **Error! Reference source not found..**

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS:8887-2004 and must be PSU manufacturers or sourced from Mittal Petro Pharma Chem or S.M.S.Refuels with following conditions

- 1) Submission of MTC (Manufactures Test Certificates) Along with Third party Test Reports from NABL accredited Laboratory for individual projects.
- 2) Field tests of indiviul batch/lots to be carried out before allowing the material to be used.

#### **Weather and Seasonal Limitations**

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

#### **Construction**

##### **Equipment**

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at the rate of **0.85 kg per SM**. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

##### **Preparation of Road Surface**

Prime coat must be applied immediately after compaction of WMM upto 98% Maximum dry density is achieved on field.

##### **Application of Bituminous Primer**

After preparation of the road surface as per Clause 0, the primer shall be sprayed uniformly at the rate of **0.85 kg per SM**. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the

tolerances specified. No heating or dilution of SS-1 bitumen emulsion and shall be permitted at site.

### **Curing of Primer and Opening to Traffic**

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

### **Quality Control of Work**

For control of the quality of materials and the works carried out, the relevant provisions of **Error! Reference source not found.** shall apply.

### **Arrangements for Traffic**

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 0.

### **Measurement for Payment**

Prime coat shall be measured in terms of surface area of application in square meters. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### **Rate**

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for:

- i. Making arrangements for traffic to Clause 0 except for initial treatment to verges, shoulders and construction of diversions;
- ii. Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. All labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv. Carrying out the work in part widths of road where directed; and
- v. Carrying out the required tests for quality control.

Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at **0.85 kg per SM**, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 0.

### ***Item no: 5.08 Supplying and applying Rapid Setting-1 (RS-I)***

***5.08 Supplying and applying Rapid Setting-1 (RS-I) bitumen emulsion confirming to IS 8887, for application of Tack coat before application of binder course at the rate of 0.27 kg. per Sq. Meter area, including all materials, labour, machinery, tests required to be carried out with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.***

***Supplying and applying RS-1 bitumen emulsion conforming to IS 8887, for application of Tack coat before application of binder course at the rate of 0.27 kg. per Sq. Meter area.***

The work shall consist of the application of a single coat of bitumen emulsion to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Chapter **Error! Reference source not found.**

### **Materials**

The binder used for tack coat shall be either Cationic bitumen emulsion (RS-1) complying with IS:8887. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

The binder used for tack coat shall be Cationic bitumen emulsion RS-1 grade conforming physical and chemical properties shown in Table 10. The rate of application of Tack coat on Granular surfaces treated with primer is **0.27 kg/sq.mt.**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C.

**Table 10 Physical and Chemical properties of Bitumen Emulsion Grade RS-1**

<b>Sr. No.</b>	<b>Properties</b>	
1	Residue on 600 micron IS Sieve, percent by mass, (Max)	0.05
2	Viscosity by sayboltfurol viscometer, seconds: At 50° C	20-100
3	Coagulation of emulsion at low temperature	Nil
4	Storage stability after 24 h, percent (Max)	2
5	Particle charge	Positive
6	Miscibility with water	No coagulation
7	Tests on residue:	
	A. Residue by evaporation, percent, (Min)	60
	B. Penetration 25°C/100g/5 sec	80-150
	C. Ductility 27° C/cm, A4in	50
	D. Solubility: In trichloroethylene, percent by mass (Min)	98

If Emulsion is stored for more than 90 days, its properties as mentioned in Table 10 should be checked apart from the frequency mentioned.

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS:8887-2004 and must be PSU manufacturers.

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Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS:8887-2004 and must be PSU manufacturers or sourced from Mittal Petro Pharma Chem or S.M.S.Refuels with following conditions.

- 1) Submission of MTC (Manufactures Test Certificates) Along with Third party Test Reports from NABL accredited Laboratory for individual projects.
- 2) Field tests of indiviul batch/lots to be carried out before allowing the material to be used.

### **Weather and Seasonal Limitations**

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. The surface shall be slightly damp, but not wet while using emulsion.

### **Construction**

#### **Equipment**

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a rate of **0.27 kg per SM** Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

#### **Preparation of Base**

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of MoRTH-2013 (Fifth Revision) Clauses 501.8. The granular surfaces shall be primed as per Chapter **Error! Reference source not found.** immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

#### **Application of Tack Coat**

The application of tack coat shall be at the rate of **0.27 kg per SM**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

#### **Curing of Tack Coat**

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

#### **Quality Control of Work**

For control of the quality of materials and the works carried out, the relevant provisions of **Error! Reference source not found.** shall apply.

#### **Arrangements for Traffic**

**Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 0.

**Measurement for Payment**

Tack coat shall be measured in terms of surface area of application in square meters. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Rate**

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for:

- i. Making arrangements for traffic to Chapter 0 except for initial treatment to verges, shoulders and construction of diversions;
- ii. Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. All labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv. Carrying out the work in part widths of road where directed; and
- v. Carrying out the required tests for quality control.

The rate shall cover the provision of tack coat, at the rate of **0.27 kg per SM**, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

***Item no. 5.09 Providing and laying Dense-graded Bituminous Macadam***

***5.09 Providing and laying DENSE GRADED BITUMINOUS MACADAM as per gradation and bitumen for mixing shall be as arrived from mix design, provided in no case it shall be less than 4.0% for Grade I and 4.5% for Grade II by wt. of total mix as binder by batch mix type hotmix plant and laying by sensor paver finisher including consolidation by rollers as specified including providing and operating plant, sensor paver and machinery, cost of fuel, oil lubricant and labour charges including cost of aggregate and filler (if found required as per mix design)etc complete***

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 75 mm for DBM-II, whereas it can be 75 mm to 100 mm with DBM-I in case of redesigning the pavement for achieved soaked CBR value being lower than design soaked CBR of 8%.

**Materials****Bitumen**

The bitumen shall be viscosity grade paving bitumen VG 30 complying with the Indian Standard Specification IS: 73 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be VG 30 grade of paving bitumen satisfying specified in

Table 11.

**Table 11 Requirements for Paving Bitumen VG 30**

Sr. No.	Characteristics	Requirement
1	Penetration at 25°C, 100 g, 5 s, 0.1 mm, Min	45
2	Absolute viscosity at 60°C, Poises	2400-3600
3	Kinematic viscosity at 135°C, cSt, Min	350
4	Flash point (Cleveland open cup), °C, Min	220
5	Solubility in trichloroethylene, percent, Min	99
6	Softening point (R&B), °C, Min	47
7	Tests on residue from rolling thin film oven test:	
	a) Viscosity ratio at 60°C, Max	4.0
	b) Ductility at 25°C, cm, Min	40

### Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. The aggregates shall satisfy the requirements specified in Table 12. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces. Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75-micron sieve. Natural sand shall not be allowed in binder courses. However, natural sand up to 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS: 2720 (Part 37). The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS: 2720 (Part 5).

**Table 12 Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam**

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV

Durability	Soundness:Sodium Sulphate or Magnesium Sulphate	Max 12% Max18%	IS:2386 Part V
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength	Min. 80%	AASHTO 283

### Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 13 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

**Table 13 Composition of Dense Graded Bituminous Macadam**

Grading	1	2
Nominal aggregate size <sup>5</sup>	37.5 mm	26.5 mm
Layer thickness	75 - 100 mm	50 - 75 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45	100	-
37.5	95 - 100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-

<sup>5</sup>The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

0.6	-	-
0.3	7-21	7-2
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix	Min 4.0 <sup>6</sup>	Min 4.5 <sup>7</sup>

### Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2. Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 15 shall be multiplied by 2.25, and the minimum flow shall be 3 mm. The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2. Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 14. Alternatively, minimum bitumen content recommended as given in Table 13 can be used for production of mix, provided the mix satisfies the requirements as given in Table 13, Table 14 and Table 15. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity ( $G_{mm}$ ) obtained on the day of compaction in accordance with ASTM D 2041.

**Table 14 Requirements for Dense Graded Bituminous Macadam**

Properties	Requirement	Test Method
Compaction level	75 blows on each face of the specimen	
Minimum stability (kN at 60°C)	9.0	AASHTO T245
Marshall flow (mm)	2-4	AASHTO T245
Marshall Quotient (Stability/Flow)	2-5	MS-2 and ASTM D2041
% air voids	3-5	
% Voids Filled with Bitumen (VFB)	65-75	
Coating of aggregate particle	95% minimum	IS: 6241

<sup>6</sup>Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

<sup>7</sup>Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

Tensile Strength ratio	80% Minimum	AASHTO T 283
% Voids in Mineral Aggregates(VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 15	

**Table 15 Minimum Percent Voids in Mineral Aggregate (VMA)**

Nominal Maximum Particle Size (mm)	Minimum VMA Percent Related to Design Percentage A voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

### Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i. Source and location of all materials
- ii. Proportions of all materials expressed as follows:
  - a) Binder type, and percentage by weight of total mix
  - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler
- iii. A single definite percentage passing each sieve for the mixed aggregate
- iv. The individual grading of the individual aggregate fraction, and the proportion of each in the combined grading
- v. The results of mix design such as maximum specific gravity of loose mix ( $G_{mm}$ ), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test
- vi. Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch
- vii. Test results of physical characteristics of aggregates to be used
- viii. Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

**Plant Trials - Permissible Variation in Job Mix Formula**

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 16 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with MoRTH-2013 (Fifth revision) Section 900.

**Table 16 Permissible Variations in the Actual Mix from the Job Mix Formula**

<b>Description</b>	<b>Base/binder Course</b>
Aggregate passing 19 mm sieve or larger	±8%
Aggregate passing 13.2 mm, 9.5 mm	±7%
Aggregate passing 4.75 mm	±6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±5%
Aggregate passing 0.3 mm, 0.15 mm	±4%
Aggregate passing 0.075 mm	±2%
Binder content	±0.3%
Mixing temperature	± 10°C

**Construction Operations****Weather and Seasonal Limitations**

Laying shall be suspended:

- i. In presence of standing water on the surface;
- ii. When rain is imminent, and during rains, fog or dust storm;
- iii. When the base/binder course is damp;
- iv. When the air temperature on the surface on which it is to be laid is less than 10°C for mixes with conventional bitumen;

**Preparation of Base**

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Chapter 0 and chapter **Error! Reference source not found..**

**Prime Coat**

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Chapter **Error! Reference source not found..**

**Tack Coat**

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Chapter **Error! Reference source not found..**

**Mixing and Transportation of the Mix**

### Mixing and Transportation of the Mix

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures are given in Table 17 of these Specifications. The difference in temperature between the binder and aggregate shall at no time exceed 14°C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time.

**Table 17 Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celsius)**

Bitumen viscosity grade	Bitumen Temperature	Aggregate Temperature	Mixed material Temperature	Laying Temperature	<sup>8</sup> Rolling Temperature
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	130 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

If a continuous type mixing plant is used, the Contractor must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for that bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading. Table 17 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen.

In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

Bituminous materials shall be transported in clean insulated and covered vehicles. An asphalt release agent, such as soap or lime water, may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

### Spreading

Prior to spreading the mix, the base shall be prepared by carrying out the required operations as per MoRTH-2013 (Fifth revision) Clause 501.8 depending upon the site conditions. Except in areas where paver cannot get access, bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machine equipped with an electronic sensing device. The essential features of the paver finisher shall conform to Annex A of IRC:27. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver,

<sup>8</sup>Rolling must be completed before the mat cools to these minimum temperatures.

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and its method of operations, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space (such as confined space, foot ways, of irregular shape and varying thickness, approaches to expansion joints, etc.) where paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by trained staff.

The minimum thickness of material laid in each paver pass shall be in accordance with, the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement up to the joint, and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material, with a temperature greater than 145°C, shall not be laid or deposited on bridge deck water-proofing systems, unless precautions against heat damage.

Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated, the Contractor shall make it good to the satisfaction of the Engineer, in compliance with MoRTH-2013 (Fifth revision) Clause 501.8.

Binder course material shall be covered by either the wearing course or surface treatment, whichever is specified in the Contract.

### **Rolling and Compaction**

Bituminous materials shall be laid and compacted in layers, which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these Specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, rolling shall commence at the edges and progress towards the center longitudinally except that on super-elevated and unidirectionally cambered portions, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall be made good by the attendants behind the paver, before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonne static weight smooth-wheel rollers. The intermediately rolling shall be done with 8-10 tonne static weight or vibratory roller or with a pneumatic tyre roller of 12 to 15 tonne weight, with a tyre pressure of at least 0.56 MPa. The Contractor shall demonstrate the efficiency of the equipment proposed to be used by carrying compaction trials. The procedure for site trials shall be submitted to the Engineer for approval. The finish rolling shall be done with 6 to 8 tonne smooth wheel tandem rollers. Rolling shall continue until the specified compaction is achieved.

Where compaction is to be determined by density of cores, the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the Contractor shall specify the plant, and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction, with the driven rolls nearest the paver. The roller shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roll or, in the case of a pneumatic-tyred roller, at least the nominal width of 300 mm.

In portions with super-elevated and unidirectional camber, after the edge has been rolled, the roller shall progress from the lower to the upper edge.

Rollers should move at a speed of not more than 5 km per hour. The roller shall not be permitted to stand on pavement which has not been fully compacted, and necessary precautions shall be taken to prevent dropping of oil, grease, petrol, diesel or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of roller machine shall be in good working order, to prevent the mix from adhering to the Wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mix should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

Where joints are made, the material shall be fully compacted and the joint made flush in one of the following ways:

- A. All joints shall be cut vertical to the full thickness of the previously laid mix. All loosened material shall be discarded and the vertical face coated with a suitable viscosity grade hot bitumen, or cold applied emulsified bitumen. While spreading the material along the joint the material spread shall overlap 25 mm to 50 mm on the previously laid mix beyond the vertical face of the joint. The thickness of the loose overlap material should be approximately a quarter more than the final compacted thickness. The overlapped mix shall be dragged back to the hot lane so that the roller can press the small excess into the hot side of the joint to obtain a high joint density.
- B. By using two or more pavers operating in echelon, where this is practicable and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling. All longitudinal joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed, and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking, whichever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

For transverse joints method A above shall apply. Transverse joints in the successive and adjoining layers shall have a minimum offset of 2 m.

The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials.

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**Opening to Traffic**

It shall be ensured that the traffic is not allowed, on the surface until the dense bituminous layer has cooled to the ambient temperature.

**Surface Finish and Quality Control of Work****Horizontal Alignment**

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of  $\pm 10$  mm there from.

**Surface Levels**

The levels of the Binder course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 6$  mm.

For checking compliance with the above requirement for Dense graded Bituminous Macadam, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

**Surface Evenness**

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 6 mm for Dense graded Bituminous Macadam.

**Quality Control**

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision) which is reproduced in chapter **Error! Reference source not found..**

**Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 0.

**Measurement for Payment**

Dense Graded Bituminous Materials shall be measured as finished work either in cubic meters, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Rate**

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed below,

- i. Making arrangements for traffic to Clause 0 except for initial treatment to verge, shoulders and construction of diversions;
- ii. Cleaning of the surface;
- iii. Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;
- iv. Mixing, transporting, laying and compacting the mix, as specified including all wastage in cutting joints;
- v. All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machinery, incidental to complete the work to these Specifications;
- vi. Carrying out the work in part widths of the road where directed;
- vii. Carrying out all tests for control of quality;
- viii. The rate shall cover the provision of bitumen at the application rate specified in the contract, with the provision that the variation in actual percentage of bitumen used shall be assessed and the payment adjusted accordingly as per Contract;
- ix. The rates include for all testing, mix design, transporting and testing of samples, and cores and tests as directed by the Engineer; and
- x. The cost of all plant and laying trials as specified to prove the mixing and laying methods shall be deemed to be included in the Contractor's rates.

The rate shall include the provision of bitumen, at 4 percent and 4.5 percent by weight of the total mixture for grading 1 and grading 2 respectively. The variation in actual percentage of bitumen used shall be assessed and the payment adjusted plus or minus accordingly.

***Item no. 5.10 Supplying and applying Rapid Setting-1 (RS-I)***

***5.10 Supplying and applying Rapid Setting-1 (RS-I) bitumen emulsion confirming to IS 8887, for application of Tack coat before application of wearing course at the rate of 0.25 kg. per Sq. Meter area, including all materials, labour, machinery, tests required to be carried out with all leads and lifts etc., complete as per details in tender specification & as directed by engineer in charge.***

***Supplying and applying RS-1 bitumen emulsion confirming to IS 8887, for application of Tack coat before application of wearing course at the rate of 0.25 kg. per Sq. Meter area.***

The work shall consist of the application of a single coat of bitumen emulsion to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Chapter 0.

**Materials**

The binder used for tack coat shall be either Cationic bitumen emulsion (RS-1) complying with IS:8887. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

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The binder used for tack coat shall be Cationic bitumen emulsion RS-1 grade conforming physical and chemical properties shown in Table 10. Rate of application of Tack coat on Granular surfaces treated with primer shall be **0.25 kg/Sq. Meter.**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C.

If Emulsion is stored for more than 90 days, its properties as mentioned in Table 10 should be checked apart from the frequency mentioned in **Error! Reference source not found.**

Preferred source for bitumen emulsion is Hindustan Colas Ltd. (HINCOL) or equivalent industry which follows standards of IS:8887-2004 and must be PSU manufacturers or sourced from Mittal Petro Pharma Chem or S.M.S.Refuels with following conditions.

- 1) Submission of MTC (Manufactures Test Certificates) Along with Third party Test Reports from NABL accredited Laboratory for individual projects.
- 2) Field tests of indiviul batch/lots to be carried out before allowing the material to be used.

### **Weather and Seasonal Limitations**

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet.

### **Construction Equipment**

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

### **Preparation of Base**

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of MoRTH-2013 (Fifth Revision) Clauses 501.8. immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

### **Application of Tack Coat**

The application of tack coat shall be at the rate of **0.25 kg per SM**, and it shall be applied uniformly. No dilution or heating at site of RS-1 bitumen emulsion shall be permitted. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The

Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

### **Curing of Tack Coat**

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

### **Quality Control of Work**

For control of the quality of materials and the works carried out, the relevant provisions of **Error! Reference source not found.** shall apply.

### **Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 0.

### **Measurement for Payment**

Tack coat shall be measured in terms of surface area of application in square meters. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### **Rate**

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for:

- i. Making arrangements for traffic to Chapter 0 except for initial treatment to verges, shoulders and construction of diversions;
- ii. Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. All labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv. Carrying out the work in part widths of road where directed; and
- v. Carrying out the required tests for quality control.

The rate shall cover the provision of tack coat, at the rate of **0.25 kg per SM**, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

### ***Item no. 5.11 Providing and laying Bituminous Concrete***

***5.11 Providing and laying 25mm to 50mm thick compacted BITUMINOUS CONCRETE using aggregates as per gradation and percentage of bitumen for mixing shall be as arrived from mix design, provided in no case bitumen percentage shall be less than 5.2% for Grade I and 5.4% for Grade II by Wt. of total mix as binder by batch mix type hot mix plant and laying by sensor paver finisher including consolidation by rollers as specified including providing and operating plant, sensor paver and machinery, cost of fuel, oil, lubricant and labour charges including cost of aggregate and filler (if found required as per mix design) etc. complete***

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of

bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

## Materials

### Bitumen

The bitumen shall be viscosity grade paving bitumen VG 30 complying with the Indian Standard Specification IS: 73 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be VG 30 grade paving bitumen satisfying the requirements specified in Table 18.

**Table 18 Requirements for Paving Bitumen VG 30**

Sr.No.	Characteristics	Requirement as per IS:73
1	Penetration at 25°C, 100 g, 5 s, 0.1 mm, Min	45
2	Absolute viscosity at 60°C, Poises	2400-3600
3	Kinematic viscosity at 135°C, cSt, Min	350
4	Flash point (Cleveland open cup), °C, Min	220
5	Solubility in trichloroethylene, percent, Min	99
6	Softening point (R&B), °C, Min	47
7	Tests on residue from rolling thin film oven test:	
	a) Viscosity ratio at 60°C, Max	4.0
	b) Ductility at 25°C, cm, Min	40

### Aggregates

The coarse aggregates shall be generally as specified in MoRTH-2013 (Fifth revision) Clause 504.2.2, except that the aggregates shall satisfy the physical requirements of Table 19 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

**Table 19 Physical Requirements for Course Aggregate for Bituminous Concrete**

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle Shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value	Max 30%	IS:2386 Part IV

	or Aggregate Impact Value	Max 24%	
Durability	Soundness either: Sodium Sulphate or Magnesium Sulphate	Max 12%  Max 18%	IS:2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2336 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength <sup>9</sup>	Min 80%	AASHTO 283

### Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1, the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in Table 20. The grading shall be as specified in the Contract.

**Table 20 Composition of Bituminous Concrete Pavement Layers**

Grading	1	2
Nominal aggregate size <sup>10</sup>	19 mm	13.2 mm
Layer thickness	50 mm	30—40 mm
IS Sieve(mm)	Cumulative % by weight of total aggregate passing	
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58

<sup>9</sup>If the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is recommended to meet the requirement

<sup>10</sup>The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.

1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 5.2 <sup>11</sup>	Min 5.4 <sup>12</sup>

### Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2. The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2. Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 21. Alternatively, minimum bitumen content recommended as given in Table 20 can be used for production of mix, provided the mix satisfies the requirements as given in Table 20, Table 21 and Table 22. The compacted layers of Bituminous Concrete (BC) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity ( $G_{mm}$ ) obtained on the day of compaction in accordance with ASTM D2041.

**Table 21 Requirements for Bituminous Concrete**

Properties	Requirement	Test Method
Compaction level	75 blows on each face of the specimen	
Minimum stability (kN at 60°C)	9.0	AASHTO T245
Marshall flow (mm)	2-4	AASHTO T245
Marshall Quotient (Stability/Flow)	2-5	MS-2 and ASTM D2041
% air voids	3-5	
% Voids Filled with Bitumen (VFB)	65-75	

<sup>11</sup>Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

<sup>12</sup>Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately.

Coating of aggregate particle	95% minimum	IS: 6241
Tensile Strength ratio	80% Minimum	AASHTO T 283
% Voids in Mineral Aggregates(VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 22	

**Table 22 Minimum Percent Voids in Mineral Aggregate (VMA)**

Nominal Maximum Particle Size (mm)	Minimum VMA Percent <sup>13</sup> Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

### Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i. Source and location of all materials
- ii. Proportions of all materials expressed as follows:
  - a) Binder type, and percentage by weight of total mix
  - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler
- iii. A single definite percentage passing each sieve for the mixed aggregate
- iv. The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading
- v. The results of mix design such as maximum specific gravity of loose mix ( $G_{mm}$ ), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test
- vi. Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch
- vii. Test results of physical characteristics of aggregates to be used
- viii. Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

<sup>13</sup>Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

#### **Plant Trials - Permissible Variation in Job Mix Formula**

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 23 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with MoRTH-2013 (Fifth revision) Section 900.

**Table 23 Permissible Variations in the Actual Mix from the Job Mix Formula**

Description	Base/binder Course
Aggregate passing 19 mm <i>sieve</i> or larger	±7%
Aggregate passing 13.2 mm, 9.5 mm	±6%
Aggregate passing 4.75 mm	±5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±4%
Aggregate passing 0.3 mm, 0.15 mm	±3%
Aggregate passing 0.075 mm	±1.5%
Binder content	±0.3%
Mixing temperature	± 10°C

#### **Construction Operations**

##### **Weather and seasonal limitations**

Laying shall be suspended:

- i. In presence of standing water on the surface;
- ii. When rain is imminent, and during rains, fog or dust storm;
- iii. When the base/binder course is damp;
- iv. When the air temperature on the surface on which it is to be laid is less than 10°C for mixes with conventional bitumen and is less than 15°C for mixes with modified bitumen;
- v. When the wind speed at any temperature exceeds the 40 km per hour at 2 m height.

##### **Preparation of base**

The surface on which the Bituminous Concrete is to be laid shall be prepared in accordance with MoRTH-2013 (Fifth revision) Clauses 501 and Clause 902 as appropriate. The surface shall be thoroughly swept clean by mechanical broom and dust removed by

compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

### Tack coat

Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Chapter **Error! Reference source not found.**

### Mixing and transportation of the mixture

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures can be found in Table 24 of these Specifications; the difference in temperature between the binder and aggregate should at no time exceed 14°C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time.

**Table 24 Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celsius)**

Bitumen viscosity grade	Bitumen Temperature	Aggregate Temperature	Mixed material Temperature	Laying Temperature	<sup>14</sup> Rolling Temperature
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	130 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

If a continuous mixing plant is to be used for mixing the bituminous bound macadam, the Contractor must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for that bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading. Further details are available in the Manual for Construction and Supervision of Bituminous Works.

Bituminous materials shall be transported in clean insulated vehicles, and unless otherwise agreed by the Engineer, shall be covered while in transit or awaiting tipping. Subject to the approval of the Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

### Spreading

The general provisions of MoRTH-2013 (Fifth revision) Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

<sup>14</sup>Rolling must be completed before the mat cools to these minimum temperatures.

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**Rolling**

The general provisions of MoRTH-2013 (Fifth revision) Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

**Opening to Traffic**

The bituminous macadam shall be *covered* with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, by the Contractor the course shall be covered by a seal coat to the requirement of MoRTH-2013 (Fifth revision) Clause 512 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

**Surface Finish and Quality Control****General**

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

**Horizontal Alignment**

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of  $\pm 10$  mm there from.

**Surface Levels**

The levels of the Wearing course shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 6$  mm, in case of machine laid mix and  $\pm 10$  mm, in case of manually laid mix.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than the following limits:

- 4 mm for bituminous wearing course of thickness 40 mm or more
- 3 mm for bituminous wearing course of thickness less than 40 mm
- 5 mm for concrete pavement slab

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the center of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

**Surface Regularity of Pavement Courses**

The longitudinal profile shall be checked with a 3 meter long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table 4.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 3 mm for Bituminous Concrete.

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**Rectification**

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 0, the Contractor shall be liable to rectify these in the manner described below.

For bituminous construction, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat, if needed, and re-compacting as per specifications. Where the surface is high, the extra thickness in the affected layer shall be removed and replaced with fresh material and compacted to Specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

**Riding Quality**

The riding quality of bituminous concrete wearing surface, as measured by a standard towed fifth wheel bump integrator, shall not be more than 2000 mm per Km.

**Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 0.

**Measurement for Payment**

Bituminous Concrete Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

**Rate**

The contract unit rate for Semi-Dense Bituminous Concrete shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed below,

- i. Making arrangements for traffic to Clause 0 except for initial treatment to verge, shoulders and construction of diversions;
- ii. Cleaning of the surface;
- iii. Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;
- iv. Mixing, transporting, laying and compacting the mix, as specified including all wastage in cutting joints;
- v. All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machinery, incidental to complete the work to these Specifications;
- vi. Carrying out the work in part widths of the road where directed;
- vii. Carrying out all tests for control of quality;

- viii. The rate shall cover the provision of bitumen at the application rate specified in the contract, with the provision that the variation in actual percentage of bitumen used shall be assessed and the payment adjusted accordingly as per Contract;
- ix. The rates include for all testing, mix design, transporting and testing of samples, and cores and tests as directed by the Engineer; and
- x. The cost of all plant and laying trials as specified to prove the mixing and laying methods shall be deemed to be included in the Contractor's rates.

The rate shall include the provision of bitumen, at 5.2 percent and 5.4 percent for grading 1 and grading 2 by weight of the total mixture respectively. The variation in actual percentage of bitumen used will be assessed and the payment adjusted plus or minus, accordingly.

### ***Item no. 5.12 Collecting, carting and stacking Stone Dust***

***5.12 Collecting, carting and stacking Stone Dust on road side as directed and flushing the same on Bituminous surfaces at the rate of 0.30 cmt. per 10 smt. as directed by Engineer in charge.***

#### **Description**

Stone dust required for the work shall be clean properly graded, free from organic materials silt clay, clods, grass roots etc. and shall be got approved from Engineer.

The material shall be stacked inform of chatta on a fairly level ground. It shall be stacked on road land beyond the top of the bank and on level conveying with all leads and lifts of the works site and

Stacking. Material shall be collected in required quantity only at required stage of work. The stone dust shall pass 100% from 600 micron and pass 85 to 100% from 75 micron sieve.

Before flushing the stone dust, it shall be thoroughly cleaned and free from all organic materials. Stone dust spreaded at the rate of 0.03 cu.mt. per 10 sq.mt. To ensure that the required stone dust used, the road surface shall be marked into length and breadth. The flushing shall be done as per direction of Engineer. The payment shall be made on square meter basis. The rate includes collecting carting and stacking to site and flushing on bitumen surface at required rate.

### ***Item no. 5.13 Preparing surfaces***

***5.13 Preparing surfaces by excavating with spades, scraping with shovel, brushing with wire brushes for removing caked mud up to 150mm thick etc. sweeping with brooms and finally fanning the cleaned surface with gunny bags to remove all loose dirt etc. including carting of excavated stuff from site.***

This work shall consist of preparing an existing granular or black-topped surface for laying bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean, and treated with Prime or Tack coat where specified in the Contract.

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**Construction operations for Preparing Existing Granular Surface**

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Where the existing surface is granular, all loose materials shall be removed, and the surface lightly watered where the profile corrective course to be provided as a separate layer is also granular. Where the profile corrective course of bituminous material is to be laid over the existing granular surface, the latter shall, after removal of all loose material, be primed in accordance with Clause 502 and a tack coat applied in accordance with Chapter0.

The surface of all granular layers on which bituminous works are to be placed, shall be free from dust. All such layers must be capable of being swept, after the removal of any non-integral loose material, by means of a mechanical broom, without shedding significant quantities of material and dust removed by air jet, washing, or other means approved by the Engineer. After cleaning, the surface shall be correct to line and level within the tolerances specified for base course.

***Item no. 5.14 Picking***

***5.14 Picking of the bituminous surface using JCB excavator or by any mechanical means, cleaning and removal of loose and unsuitable material on the road surface including cost of fuel, oil, lubricant, labour charges and disposal of loose unsuitable material from site to the disposal site as directed by Engineer in charge.***

**Description**

This work shall consist scratching of existing top bituminous layer i.e. wearing coat up to 20mm depth in the specified width which shall be partly removed with care and without causing undue disturbance to the underlying layer with suitable equipment such as JCB excavator as per instruction of Engineer. It also includes removing and stacking reusable/unusable materials, disposal of unusable materials within lead of 5 km. from the site of work as directed by Engineer. This work shall be carried out for re-carpeting the existing bituminous roads only. This work shall be carried out in such a way that actual picking area shall be minimum 25 % of the area to be re-carpeted.

**Mode of Payment**

The payment shall be made on sq.mt. basis. The payment shall be made only for the once which has been carried out generally up to 20 mm. depth by JCB excavator as directed by Engineer.

***Item no. 5.15 Carting and conveying of bulk bitumen***

***5.15 Carting and conveying of bitumen from refinery / any depot of oil companies to Surat including loading unloading in suitable tanks/drums etc. Complete***

Entire quantity of asphalt required for this work shall be carted by the contractor completely at his cost and risk from therefinery or any depot of Refinery as directed by Engineer for which the following terms and condition shall be binding to him.

1. All the original bills and gate passes issued by Refinery shall be in the name of Surat Municipal Corporation for this tender work only.

2. All the gate-passes in original issued by the refinery shall have to be submitted to the Engineer.
3. The vehicle Number of the tanker carrying the asphalt shall be shown correspondingly on the gate pass.
4. The contractor shall produce original purchase bill indicating the quality grade of asphalt and shall also produce test results/certificate regarding grade for the same in original.
5. A register showing day to day receipt, consumption and balance of asphalt shall have to be maintained at the site of work by the contractor.
6. The weight of bulk asphalt supplied shall be taken as per verification of actual net weight at weigh bridge installed at Hotmix plant site either at Bhatar or any other S.M.C. plant site.
7. If difference between each tanker's weight as per suppliers/refinery bill and SMC weigh bridge may cross +/- 1% by weight, the differed quantity shall be recovered from the contractor at the rate at the time of execution of the work or at the rate of Rs.30,000/- per M.T. whichever is more.

#### **Mode of Payment**

The payment shall be made on M.T. basis.

### **Section: 6 Cement Concrete Pavement**

#### ***Item No: 6.01 Providing and laying Granular Sub Base***

***6.01 Providing and laying Granular Sub Base (drainage layer) conforming to Grading V of Table 400.2 of compacted thickness of 100 mm with specified graded stone metal and sand mixed in pugmill and laid with mechanical means spreading with motor grader and compacting with vibratory roller having minimum 80-100KN static weight to achieve desired density of 98% of MDD including all material, labour, machinery with all leads and lifts etc., complete.***

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one layer as sub-base according to lines, grades and cross-sections shown on the drawings.

#### **Material requirements**

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in **Table 5** and physical requirements given in **Table 6**. If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table 5 Grading for Granular Sub-base (GSB-V) Materials

IS size (mm)	Percent by Weight Passing the IS Sieve (Grading-V)
75.0	100
53.0	80-100
26.5	55-90
9.50	35-65
4.75	25-50
2.36	10-20
0.85	2-10
0.425	0-5
0.075	-

Table 6 Physical Requirements for Materials for Granular Sub-base

Physical properties	Test procedure	Requirement
Aggregate Impact Value (%)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit (%)	IS:2720 (Part 5)	Maximum 25
Plasticity Index (%)	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS: 2720-Part 8) (%)	IS:2720 (Part 5)	Minimum 30

## Construction Operations

### Preparation of diameter

Immediately prior to the laying of sub-base, the subgrade already finished as mentioned in ITEM NO. 5 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

### Spreading and Compacting

The Granular sub-base material of the grading-V and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing so as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate, capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or

on superelevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the proceeding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

## Surface Finish and Quality Control of Work

### General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings, subject to the permitted tolerances described herein-after.

### Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the Centre line of the carriageway as shown on the drawings. The tolerance for edges of the roadway and Sub-base layers of pavement shall be  $\pm 25$  mm.

### Surface Levels

The levels of the Granular sub-base shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings beyond the tolerances limit of  $\pm 10$  mm.

For checking compliance with the above requirement for Granular sub-base, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

### Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3-meter-long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road. The maximum permitted number of surface irregularities shall be as per Table.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be 8 mm for Granular Sub-base.

Table 7 Maximum Permitted Number of Surface Irregularities

	Surfaces of carriageways and Paved shoulder		Surfaces of Laybys, Service areas and all Bituminous Base courses	
<b>Irregularity</b>	<b>4 mm</b>	<b>7 mm</b>	<b>4 mm</b>	<b>7 mm</b>

Length	300	75	300	75	300	75	300	75
<b>Number of Surface Irregularities on Roads of all Category<sup>15</sup></b>	40	18	4	2	60	27	6	3

### Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 4, the Contractor shall be liable to rectify these in the manner described below.

Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of MoRTH-2013 (Fifth revision) Clause 401. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 MoRTH-2013 (Fifth revision).

### Arrangements for Traffic

During the period of construction, arrangement for traffic shall be provided and maintained in accordance with Clause 112.

### Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic meters. The protection of edges of granular sub-base extended over the full formation width shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

### Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- 8 Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions.
- 9 Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts.
- 10 All labour, tools, equipment and incidentals to complete the work to the Specifications.
- 11 Carrying out the work in part widths of road where directed.

Carrying out the required tests for quality control

### ***Item No: 6.02 Providing and laying Dry Lean Concrete sub base***

***6.02 Providing and laying Dry Lean Concrete sub base including providing coarse and fine aggregate to the specified gradation using minimum cement content 150 kg/cum of concrete with OPC 53 grade cement, mixing of concrete as per approved design mix using mechanized batch mix plant of appropriate capacity, transporting and laying and compacting with vibratory roller of minimum 80-100KN static weight to give desired***

<sup>15</sup> Category of each section of road as described in the Contract

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*compacted density and average compressive strength of 10MPa at 7 days and curing with liquid curing compound and sprinkling water and covering with moist hessian or ponding of water for 7 days including providing construction joints, including all material, labour, machinery with all leads and lifts etc., complete*

## **SPECIFICATIONS FOR DRY LEAN CEMENT CONCRETE (SUB-BASE) (MOR&TH)**

### **DRY LEAN CEMENT CONCRETE (SUB-BASE)**

#### **Scope**

The work shall consist of construction of dry lean concrete sub base for cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations, in connection with the work, as approved by the Engineer.

The design parameters of dry lean concrete sub-base, viz., width, thickness, grade of concrete, details of joints, if any, etc. shall be as stipulated in the Contract drawings.

#### **Materials**

##### **Source of Materials:**

The Contractor shall indicate to the Engineer the source of all materials with relevant test data to be used in the lean concrete work sufficiently in advance and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work. If the Contractor later proposes to obtain the materials from a different source, he shall notify the Engineer for his approval at least 45 days before such materials are to be used.

##### **Cement:**

Any of the following types of cement may be used with prior approval of the Engineer:

- (I) Ordinary Portland Cement IS : 269
- (II) Portland Slag Cement IS : 455
- (III) Portland Pozzolana Cement IS : 1489

If the subgrade is found to consist of soluble sulphates in a concentration more than 0.5 per cent, cement used shall be sulphate resistant and shall conform to IS: 6909.

Cement to be used may preferably be obtained in bulk form. It shall be stored in accordance with stipulations contained in Clause 1014 and shall be subjected to acceptance test prior to its immediate use.

##### **Aggregates:**

**Aggregates for lean concrete shall be natural material complying with IS: 383.** The aggregates shall not be alkali reactive. The limits of deleterious materials shall not exceed the requirements set out in IS: 383. In case the Engineer considers that the aggregates

are not free from dirt, the same may be washed and drained for at least 72 hours before batching, as directed by the Engineer.

**Coarse aggregate:**

Coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of the coarse aggregate shall be 25 mm. The coarse aggregate shall comply with Clause 602.2.4.2.

**Fine aggregate:**

The fine aggregate shall consist of clean, natural sand or crushed stone sand or a combination of the two and shall conform to IS: 383. Fine aggregate shall be free from soft particles, clay, shale, loam, cemented particles, mica, organic and other foreign matter. The fine aggregate shall comply with Clause 602.2.4.3.

**The coarse and fine aggregates may be obtained in either of the following manner:**

- (I) In separate nominal sizes of coarse and fine aggregates and mixed together intimately before use.
- (II) Separately as 25 mm nominal single size, 12.5 mm nominal size graded aggregates and fine aggregate of crushed stone or sand or 3 combinations of these two.

The material after blending shall conform to the grading as indicated in Table 600-1.

TABLE 600-1 AGGREGATE GRADATION FOR DRY LEAN CONCRETE

Sieve Designation	Percentage passing the sieve by weight
26.50 mm	100
19.00 mm	80-100
9.50 mm	55-75
4.75 mm	35-60
600.00 micron	10-35
75.00 micron	0-3

**Water:**

Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS: 456.

**Storage of materials:**

All materials shall be stored in accordance with the provisions of Clause 1014 of these Specifications and other relevant IS Specifications. All efforts must be made to store the materials in proper places so as to prevent their deterioration or contamination by foreign matter and to ensure their satisfactory quality and fitness for use in the work. The storage place must also permit easy inspection, removal and storage of materials. All such materials even though stored in approved godowns must be subjected to acceptance test immediately prior to their use. The requirement of storage yard specified in Clause 602.2.9 shall also be applicable.

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**Proportioning of Materials for the Mix**

The minimum cement content shall be 150 kg /cum of concrete and shall be proportioned in accordance with M10 grade.

**Moisture content:**

The right amount of water for the lean concrete in the main work shall be decided so as to ensure full compaction under rolling and shall be assessed at the time of rolling the trial length. Too much water will cause the lean concrete to be heaving up before the wheels and picked up on the wheels of the roller and too little will lead to inadequate compaction, a low in-situ strength and an open-textured surface.

The optimum, water content shall be determined and demonstrated by rolling during trial length construction and the optimum moisture content and degree of compaction shall be got approved from the Engineer. While lying in the main work, the lean concrete shall have a moisture content between the optimum and optimum +2 per cent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.

**Cement content:**

The minimum cement content in the lean concrete shall not be less than 150 kg/cu.m. of concrete. If this minimum cement content is not sufficient to produce concrete of the specified strength, it shall be increased as necessary without additional cost compensation to the Contractor.

**Concrete strength:**

The average compressive strength of each consecutive group of 5 cubes made in accordance with Clause 903.5.1.1 shall not be less than 10 MPa at 7 days. In addition, the minimum compressive strength of any individual cube shall not be less than 7.5 MPa at 7 days. The design mix complying with the above shall be got approved from the Engineer and demonstrated in the trial length construction.

**Subgrade**

The subgrade shall conform to the grades and cross sections shown on the drawings and shall be uniformly compacted to the design strength in accordance with these Specifications and Specification stipulated in the Contract. Subgrade material should be of Murrum type in general having CBR value of minimum 8% and Plasticity Index not exceeding 14%. Thickness of the Subgrade should be as indicated in the drawing. Compacted thickness of each layer of Subgrade shall not exceed 200mm and degree of compaction shall not be less than 97%. The lean concrete subbase shall not be laid on a subgrade softened by rain after its final preparation; surface trenches and soft spots, if any, must be properly back-filled and compacted to avoid any weak or soft spot. As far as possible, the construction traffic shall be avoided on the prepared subgrade. A day before placing of the sub-base, the subgrade surface shall be given a fine spray of water and rolled with one or two passes of a smooth wheeled roller after a lapse of 2-3 hours in order to stabilise loose surface. If Engineer feels it necessary, another fine spray of water may be applied just before placing sub-base.

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**Construction****General**

The pace and programme of the lean concrete sub-base construction shall be matching suitably with the programme of construction of the cement concrete pavement over it. The sub-base shall be overlaid with cement concrete pavement only after 7 days after sub-base construction.

**Batching and mixing:**

The batching plant shall be capable of proportioning the materials by weight, each type of material being weighed separately in accordance with Clause 602.9.3.2. The cement from the bulk stock shall be weighed separately from the aggregates. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity for the laying arrangements. The batching and mixing shall be carried out preferably in a forced action central batching and mixing plant having necessary automatic controls to ensure accurate proportioning and mixing. Other types of mixers shall be permitted subject to demonstration of their satisfactory performance during the trial length. The type and capacity of the plant shall be got approved by the Engineer before commencement of the trial length. The weighing balances shall be calibrated by weighing the aggregates, cement, water and admixtures physically either by weighing with large weighing machine or in a weigh bridge. The accuracy of weighing scales of the batching plant shall be within  $\pm 2$  per cent in the case of aggregates and  $\pm 1$  per cent in the case of cement and water.

The design features of Batching Plant should be such that the shifting operations of the plant will not take very long time when they are to be shifted from place to place with the progress of the work.

**Transporting:**

Plant mix lean concrete shall be discharged immediately from the mixer, transported directly to the point where it is to be laid and protected from the weather by covering the tippers/ dumpers with tarpaulin during transit. The concrete shall be transported by tipping trucks/dumpers, sufficient in number to ensure a continuous supply of material to feed the laying equipment to work at a uniform speed and in an uninterrupted manner. The lead of the batching plant to paving site shall be such that the travel time available from mixing to paving as specified in Clause 601.5.5.2 will be adhered to.

**Placing:**

Lean concrete shall be laid/placed by a paver with electronic sensor. The equipment shall be capable of laying the material in one layer in an even manner without segregation, so that after compaction the total thickness is as specified. The paving machine shall have high amplitude tamping bars to give good initial compaction to the sub-base.

Preferably the lean concrete shall be placed and compacted across the full width of the road, by constructing it in one go or in two lanes running forward simultaneously. Transverse and longitudinal construction joints shall be staggered by 500-1000 mm and 200-400 mm respectively from the corresponding joints in the overlaying concrete slabs.

**Compaction**

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The compaction shall be carried out immediately after the material is laid and levelled. In order to ensure thorough compaction which is essential, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is closed. The minimum dry density obtained shall be 97 per cent of that achieved during the trial length construction vide Clause 601.7. or MDD specified in sanctioned design mix of DLC. The densities achieved at the edges i.e., 0.5 m from the edge shall not be less than 95 per cent of that achieved during the trial construction vide Clause 601.7.

The spreading, compacting and finishing of the lean concrete shall be carried out as rapidly as possible and the operation shall be so arranged as to ensure that the time between the mixing of the First batch of concrete in any transverse section of the layer and the final finishing of the same shall not exceed 90 minutes when the concrete temperature is above 25 and below 30 degrees Celsius and 120 minutes if less than 25 degrees Celsius. This period may be reviewed by the Engineer in the light of the results of the trial run but in no case shall it exceed 2 hours. Work shall not proceed when the temperature of the concrete exceeds 30 degrees Celsius. If necessary, chilled water or addition of ice may be resorted to for bringing down the temperature. It is desirable to stop concreting when the ambient temperature is above 35°C. After compaction has been completed, roller shall not stand on the compacted surface for the duration of the curing period except during commencement of next day's work near the location where work was terminated the previous day.

Rolling shall be carried out by using vibratory roller of minimum 80-100 KN static weight. The number of passes required to obtain maximum compaction depends on the thickness of the lean concrete, the compatibility of the mix, and the weight and type of the roller etc., and the same as well as the total requirement of rollers for the job shall be determined during trial run by measuring the in-situ density and the scale of the work to be undertaken.

In addition to the number of passes required for compaction there shall be a preliminary pass without vibration to bed the lean concrete down and again a final pass without vibration to remove roller marks and to smoothen the surface.

Special care and attention shall be exercised during compaction near joints, kerbs, channels, side forms and around gullies and manholes. In case adequate compaction is not achieved by the roller at these points, use of plate vibrator shall be made, if so, directed by the Engineer.

The final lean concrete surface on completion of compaction and immediately before overlaying shall be well closed, free from movement under roller and free from ridges, low spots, cracks, loose material, pot holes, ruts or other defects. The final surface shall be inspected immediately on completion and all loose, segregated or defective areas shall be corrected by using fresh lean concrete material laid and compacted as per Specification. For repairing honeycombed surface, concrete with aggregates of size 10 mm and below shall be spread and compacted. It is necessary to check the level of the rolled surface for compliance. Any level/thickness deficiency should be corrected after applying concrete with aggregates of size 10 mm and below after roughening the surface. Similarly, the surface regularity also should be checked with 3m straight edge. The deficiency should be made up with concrete with aggregates of size 10 mm and below.

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Segregation of concrete in the dumpers shall be controlled by premixing each fraction of the aggregates before loading in the bin of the batching plant, by moving the dumper back and forth while discharging the mix on it and other means. Even paving operation shall be such that the mix does not segregate.

**Joints:**

Contraction and longitudinal joints shall be provided as per the drawing.

At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted material shall be cut back to a vertical face where the correct thickness of the properly compacted material has been obtained.

**Curing:**

As soon as the lean concrete surface is compacted, curing shall commence. One of the following two methods shall be adopted:

- (A) The initial curing shall be done by spraying with liquid curing compound. The curing compound shall be white pigmented or transparent type with water retention index of 90 per cent when tested in accordance with BS 7542. Curing compound shall be sprayed immediately after rolling is complete. As soon as the curing compound has lost its tackiness, the surface shall be covered with wet hessian for three days.
- (B) Curing shall be done by covering the surface by gunny bags/hessian, which shall be kept continuously moist for 7 days by sprinkling water.

**Trial Mixes**

The Contractor shall make trial mixes of dry lean concrete with moisture contents like 5.0, 5.5, 6.0, 6.5 and 7.0 per cent using cement content specified and the specified aggregate grading but without violating the requirement of aggregate-cement ratio specified in Clause 601.3.1. Optimum moisture and density shall be established by preparing cubes with varying moisture contents. Compaction of the mix shall be done in three layers with vibratory hammer fitted with a square or rectangular foot as described in Clause 903.5.1.1. After establishing the optimum moisture, a set of six cubes shall be cast at that moisture for the determination of compressive strength on the 3rd and the seventh day. Trial mixes shall be repeated if the strength is not satisfactory either by increasing cement content or using higher grade of cement. After the mix design is approved, the Contractor shall construct a trial section in accordance with Clause 601.7.

If during the construction of the trial length, the optimum moisture content determined as above is found to be unsatisfactory, the Contractor may make suitable changes in the moisture content to achieve a satisfactory mix. The cube specimens prepared with the changed moisture content should satisfy the strength requirement. Before production of the mix, natural moisture content of the aggregate should be determined on a day-to-day basis so that the moisture content could be adjusted. The mix finally designed should neither stick to the rollers nor become too dry resulting in raveling of surface.

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**Trial Length**

The trial length shall be constructed at least 14 days in advance of the proposed date of commencement of work. At least 30 days prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a "Method Statement" giving detailed description of the proposed materials, plant, equipment, mix proportion, and procedure for batching, mixing, laying, compaction and other construction procedures. The Engineer shall also approve the location and length of trial construction which shall be a minimum of 60 m length and for full width of the pavement. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid sub-base. The construction of trial length will be repeated till the Contractor proves his ability to satisfactorily construct the subbase.

In order to determine and demonstrate the optimum moisture content which results in the maximum dry density of the mix compacted by the rolling equipment and the minimum cement content that is necessary to achieve the strength stipulated in the drawing, trial mixes shall be prepared as per Clause 601.6.

After the construction of the trial length, the in-situ density of the freshly laid material shall be determined by sand replacement method with 20 cm diameter density cone. Three density holes shall be made at locations equally spaced along a diagonal that bisects the trial length; average of these densities shall be determined. These main density holes shall not be made in the strip 50 cm from the edges. The average density obtained from the three samples collected shall be the reference density and is considered as 100 per cent. The field density of regular work will be compared with this reference density in accordance with Clauses 601.5.5.1 and 903.5.1.2. A few cores may be cut as per the instructions of the Engineer to check segregation or any other deficiency.

The hardened concrete shall be cut over 3 m width and reversed to inspect the bottom surface for any segregation taking place. The trial length shall be constructed after making necessary changes in the gradation of the mix to eliminate segregation of the mix. The lower surface shall not have honey-combing and the aggregates shall not be held loosely at the edges.

The trial length shall be outside the main works. The main work shall not start until the trial length has been approved by the Engineer. After approval has been given, the materials, mix proportions, moisture content, mixing, laying, compaction plant and construction procedures shall not be changed without the approval of the Engineer.

**Tolerances for Surface Regularity, Level, Thickness, Density and Strength**

The tolerances for surface regularity, level, thickness, density and strength shall conform to the requirements given in Clause 903.5. Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

**Traffic**

No heavy commercial vehicles like trucks and buses shall be permitted on the lean concrete sub-base after its construction. Light vehicles if unavoidable may, however, be allowed after 7 days of its construction with prior approval of the Engineer.

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**Measurements for Payment**

The unit of measurement for dry lean concrete pavement shall be the cubic metre of concrete placed, based on the net plan areas for the specified thickness shown on the drawings or as directed by the Engineer.

**Rate**

The Contract unit rate payable for dry lean concrete sub-base shall be payment in full for carrying out the required operations including full compensation for all labour, materials and equipment, mixing, transport, placing, compacting, finishing, curing, testing and incidentals to complete the work as per Specifications, all royalties, fees, storage and rents where necessary and all leads and lifts.

***Item No:6.03 Providing and laying Short Slab Concrete Pavement Quality******Concrete***

***6.03 Providing and laying Short Slab Concrete Pavement Quality Concrete of M 40 grade including providing 125 micron thick impermeable plastic sheet membrane over the surface to be covered, coarse and fine aggregates of specified gradation (Table 600.3 MORT&H Rev 5th 2013 specification) Portland pozzolana cement (PPC 53) conforming to (IS: 1489 – Part 1) @ 400 kg (minimum) per cum, approved admixture and adding Recron 3S or BS EN 14889- 2: 2006, class lamicro fibers @ 910 gm/cu.mt by volume of fibers confirming to IRC SP 046-2013 cementitious material mixing in fully automatic concrete batching plant of appropriate capacity & with computerized controls, as per the design mix to the specified workability, transporting the mix with dumpers or transit mixers and laying with self propelled slip form paving train of required capacity having electronic sensor device, curing with approved resin based aluminized reflective curing compound and covering with moist hessian and ponding and sprinkling of water for a minimum period of 28 days and including auto setup of tie bars inserted with paving machine, tie bars, all types of joints and finishing to the desired surface texture including all material, labour, machinery, formwork with all leads and lifts etc. complete.***

**CEMENT CONCRETE PAVEMENT****Scope**

The work shall consist of construction of un-reinforced, dowel joint, plain cement concrete pavement in accordance with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on drawings. The work shall include furnishing of all plants and equipment, materials and labor and performing all operations in connection with work, as approved by Engineer In-Charge.

The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.

**Materials****Source of Material**

The Contractor shall indicate to the Engineer the source of all materials to be used in the concrete work with relevant test data sufficiently in advance, and the approval of the Engineer for the same shall be obtained at least before the scheduled commencement of the work in trial length. If the Contractor subsequently proposes to obtain materials from a different source during the execution of main work, he shall notify the Engineer, with relevant test data, for his approval, at least before such materials are to be used.

The work shall consist of construction of un-reinforced, dowel joint, plain cement concrete pavement in accordance with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on drawings. The work shall include furnishing of all plants and equipment, materials and labor and performing all operations in connection with work, as approved by Engineer In-Charge.

The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.

**Sub Clause**

**Cement:** Amend the paragraph one as under:

**Adding to sub clause** “Portland pozzolana cement (PPC) conforming to (IS: 1489-Part 1) shall only be used.”

Add paragraph-3 as under:

The Cement procured shall be manufactured by reputed cement producer (except companies having mini plant) with prior permission of the Engineer. The Cement shall be tested at approved laboratory preferably prior to its use in works. The cost of testing shall be borne by the Contractor. In case, the cement test results are not available before its use, the concreting work shall be permitted on the explicit understanding that the Contractor shall remove and redo the work at his own cost in case the cement specimen fails to attain the specified flexural and compressive strength.

Contractor shall provide an exclusive cement godown with capacity of minimum 1000 cement bags, under double lock system with one lock of contractor & other of SMC

Cement from locked godown will be released only by the Engineer

**Sub -Clause**

**Admixtures:**

Add the following at the end of this sub clause:

Admixtures containing calcium chloride shall not be used.

Add this to the clause

Admixture of following brands are permitted only

**Sika, BASF, Cisco, Pidilit or equivalent brand.**

**Sub-Clause**

Amend the First sentence of Paragraph one as under:

“Aggregates for pavement Concrete shall be natural material complying with IS:383 but with Los Angeles abrasion test results shall not be more than 35 per cent.”

Refer table 600-2 of MOR&TH 2013 5<sup>th</sup> Revision.

**Table 600-2 : Permissible Limits of Deleterious Substances in Fine and Coarse Aggregates**

S. No.	Deleterious Substance	Method of Test	Fine Aggregate Percentage by Weight, (Max)		Coarse Aggregate Percentage by Weight (Max)	
			Uncrushed	Crushed*	Uncrushed	Crushed*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Coal and lignite	IS:2386 (Part II)-1963	1.0	1.0	1.0	1.0
ii)	Clay lumps	do	1.0	1.0	1.0	1.0
iii)	Materials finer than 75 $\mu$ IS Sieve	IS:2386 (Part I)-1963	3.0	8.0	3.0	3.0
iv)	Soft fragments	IS:2386 (Part II)-1963	–	–	3.0	–
v)	Shale	IS:2386 (Part II)-1963	1.0	–	–	–
vi)	Total of percentages of all deleterious materials (except mica) including SI No. (i) to (v) for col 4, 6 and 7 and SI No. (i) and (ii) for col 5 only		5.0	2.0	5.0	5.0

\* Crushed aggregate at least one face fractured

**Note:** The presence of mica in the fine aggregate has been found to reduce considerably the durability and compressive strength of concrete and further investigations are underway to determine the extent of the deleterious effect of mica. It is advisable, therefore, to investigate the mica content of fine aggregate and make suitable allowances for the possible reduction in the strength of concrete or mortar; in cases where the stretch of the project road passes through micaceous belt.

### **Coarse aggregates**

Coarse aggregates shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of coarse aggregate shall not exceed 31.5 mm for pavement concrete. No aggregate which has water absorption more than 2 percent shall be used in the concrete mix. The aggregates shall be tested for soundness in accordance with IS:2386 (Part-5). After 5 cycles of testing, the loss shall not be more than 12 percent if sodium sulphate solution is used or 18 percent if magnesium sulphate solution is used. The Los Angeles Abrasion value shall not exceed 35. The combined flakiness and elongation index of aggregate shall not be more than 35 percent.

**Fine Aggregates**

The fine aggregates shall consist of clean natural sand or crushed stone sand or a combination of the two and shall conform to IS:383. Fine aggregate shall be free from soft particles. clay, shale, loam, cemented particles, mica and organic and other foreign matter. The fine aggregates shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS 2720 (Part 37).

**Combined Gradation of Fine and Coarse Aggregate**

Refer table 600-3 from MOR&TH 2013 5<sup>th</sup> Revision.

**Table 600-3 : Aggregate Gradation for Pavement Quality Concrete**

Sieve Designation	Percentage by Weight Passing the Sieve
31.5 mm	100
26.5 mm	85-95
19.0 mm	68-88
9.5 mm	45-65
4.75 mm	30-55
600 micron	8-30
150 micron	5-15
75 micron	0-5

**Water:**

Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS: 456.

**Add a new sub clause 602.2.4.4****Sub Clause      Equipment for production and processing of aggregates**

The Equipment for production and processing of Aggregate for concrete work shall conform to the requirements stated in Additional specification clause Additional technical specification 2

**Joint Seals**

Amend this clause as under:

“The joint sealing compounds shall be of cold applied either poly sulphide or poly urethane/silicone type having flexibility, resistance to age hardening and durability conforming with IRC 57”

Cold Pour Sealant shall be one of the following

- 1) poly sulphide IS:11433 part-1, BS:5212 Part-2
- 2) poly urethane BS: 5212
- 3) Silicone ASTM 5893-04

Add this to the clause

Joint Seals of following brands are permitted only

**Sika, BASF, Shipra, Pidilit, Perma or equivalent brand.**

**Sub-Clause      Concrete Strength**

**Sub- Clause** The last sentence of this Para shall read as under:  
“The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or other means approved by the Engineer and the maximum free water-cement ratio shall be 0.45.”

Add the following at the end of this Clause:

“The concrete for the rigid pavement shall be of minimum M40 Grade with a 28-day compressive characteristic strength of not less than 40 MPa and a flexural strength of not less than 4.5 MPa with a corresponding tolerance factor of 2.33.”

**Sub- Clause** **Workability**

**Sub-Clause** Delete the last sentence of the para and replace with:

“The control of workability in the field shall be exercised by Slump Test (IS: 1199) and shall be further confirmed/controlled by Compaction Factor Equipment and the compaction factor shall be in the range of 0.8 to 0.92.”

The Contractor shall carry out laboratory trials of design mix with the materials from the approved sources to be used as per IRC:44. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated, if necessary, until the proportions, that will produce a concrete which complies in all respects with these Specifications, and conform to the requirements of the design/drawings]

The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.

### **Design Mix**

The Contractor shall carry out laboratory trials of design mix with the materials from the approved sources to be used as per IRC:44. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated, if necessary, until the proportions, that will produce a concrete which complies in all respects with these Specifications, and conform to the requirements of the design/drawings.

The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.

### **Separation Membrane**

To be added at end of this Clause

“There shall be no standing water on or under the separation membrane when concrete is placed upon it.”

### **Weather and Seasonal Limitations**

#### **Concreting during Monsoon Months**

Concreting should be avoided during rainy season. However, when concrete is being placed

during monsoon months and when it may be expected to rain, sufficient supply of tarpaulin or other waterproof cloth shall be provided along the line of the work. Any time when it rains, all freshly laid concrete which had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be retextured in accordance with the directions of the Engineer

### **Temperature Limitation**

No concreting shall be done when the temperature of the concrete reaching the paving site is above 30°C. Besides, in adverse conditions like high temperature, low relative humidity. Excessive wind velocity, imminence of rains etc., tents on mobile trusses may be provided over the freshly laid concrete for a minimum period of 3 hours as directed by the Engineer. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of When the ambient temperature is more than 35°C, no concreting shall be permitted. The iceflakes should not be manufactured from chlorinated water. Generally, the rate of evaporation of water shall not exceed 1 kg/sqm/hour as per IRC:15.No concreting shall be done when the concrete temperature is below 5°C and the temperature is further falling.

### **Clause**

### **Construction**

### **Sub Clause**

Insert the following after sub para (5) after Control Cabin

“For more detail description of Batching & Mixing plant please refer additional specification clause 3. Batching & Mixing plant shall also be compliant of all the provisions contained in additional specifications 3.2.”

### **Add new clause after clause 602.9.5.6**

- i) The final regulation of the surface slab shall be provided by a longitudinal oscillating float travelling across the slab. Before the texture is applied, the longitudinal oscillating float shall complete the traverse of the slab in both directions within the length of the float and shall have a total longitudinal stroke of 200 mm to 300mm.
- ii) The longitudinal float shall either be a separate machine closely following a slip form paver or alternatively it shall be attached to a slip form paver in such a manner that it functions effectively and does not adversely affect the performance of the paver or the surface of the slab.
- iii) The longitudinal oscillating float shall have a minimum length of 3m and a minimum constant width of 250mm with a maximum weight of 10kg/m. The edges of the float shall be curved or chamfered. iv)A minimum length of 500 mm of longitudinal oscillating float shall be within the length of the machine tracks or wheels.
- v) Joint grooves shall be constructed in compliance with Clause 602.6 Where grooves are wet-formed the concrete shall be compacted around the former by a separate vibrating plate compactor with twin plates. The groove former shall be compacted to the correct level by a vibrating pan, which may be included with the transverse joint finishing beam. Final finishing shall be carried out in accordance with sub-Clause (I) of this clause. Any excess concrete on top of the

groove former shall be removed before the surface is textured.

- vi) Where a concrete slab is constructed in more than one width or where the edge needs to be matched for one level to another section of surface slab, and the surface levels at the edges are not achieved, the slab shall be supported by separate side forms placed before or after the paver to ensure that edge levels meet the required tolerances.

**Clause Curing**

**Sub clause** At the end of second paragraph of this clause add the following;  
“Additional specification clause A-3 shall also be applicable.”

**Clause Preparation and Sealing of Joint Grooves**

**Sub Clause Sealing with Sealant**

**Clause** Delete this sub clause

**Clause** Add the following at the end of the sub clause:

“Cold applied polysulphide /poly urethane sealants of either Normal Cure / Fast Cure grade shall be used and applied within the time limit by using gun. Priming over concrete surfaces is not required with polysulphide /poly urethane type sealants.”

**SPECIFICATION FOR PAVEMENT QUALITY CONCRETE FOR ROAD WORK**

- 1 The Contractors, shall have to purchase cement from open market manufactured by reputed cement companies (as mention in Vol-1). The cement shall be 53 grade PPC conforming to IS 1489 (Part-I), IS: 8112 for physical parameters and IS: 455 for chemical parameters shall be tested at Govt. Approved Laboratory at Contractor’s cost as mentioned in Table-1 from special conditions for the Ready-Mix Plant Owners, preferably before its use. In case, the cement test results are not available before its use, the concreting work shall be permitted on the explicit understanding that they will remove and redo the work at their own cost in case the cement specimen fails to attain the specified compressive strength.
- 2 PPC conforming to IS 1489 (Part-I), Portland slag cement or mixture of 53 grade cement blended with GGBS, both conforming to IS: 8112 for physical parameters and IS: 455 for chemical parameters will be allowed to be used. Contractor shall provide one independent cement godown with capacity of minimum 25000 cement bags, under double lock system with one lock of contractor & other of SMC. Cement from locked godown will be released only by the Engineer.
- 3.1 Water: The rates proposed in this tender for all concrete and allied works are inclusive of water cost. The Contractors shall have to make their own arrangements at their cost for bringing adequate water of potable quality for mixing concrete, curing purposes, etc., and for this no extra payment will be made.
- 3.2 The water brought for concreting and curing etc. shall be got tested from the approved laboratory to verify whether it is suitable for above purposes, whenever directed. This testing will be done at Contractor’s cost.

- 3.3** Contractors will have to apply for water connection and avail one metered water connection of suitable size at their cost from nearby Municipal Water main for drinking purposes. The Contractor has to pay the water bill directly to the H.E.'s Department, as per the bill raised by the H.E.'s Department. Condition No. 26 of General Conditions of Contract for Civil works, stands modified to that extent.
- 4** Sand shall be of approved quality with fineness modulus between 2.4 to 3.5 as per approved mix design. The sand will have to be screened to remove the oversized particles and washed to reduce the silt contents below 8% by volume after one hour and to bring it sand. The fine aggregates will be tested as directed by the Engineer.
- 5** If coarse aggregates are found having white spots, the same shall be got tested from approved testing laboratory to eliminate possibility of potential aggregate alkali reactivity before accepting or using spotted aggregates.
- 6** The Contractor should make the necessary arrangement to stock the aggregates separately so that they do not get mixed up with each other and/or with the foreign materials and do not get segregated. The screening of the aggregates shall be done if found necessary as directed by the Engineer.
- 7** The Contractors shall have to bring M.S./Tor steel and structural steel required for this work. M.S./Tor Steel and structural steel shall conform to Indian Standard code of practice requirements of IS: 432, IS: 1139 and IS: 1786. The steel brought on site shall be got tested at Municipal or any other approved laboratory at the Contractors cost before using on site.

### **TESTING**

- To determine the 'K' value, it is necessary to take a plate load test/CBR test within the scope of the work wherever necessary. Contractor shall arrange that his cost for excavation, loading, test and refilling. No payment will be made for this work. For conversion of K-Value to CBR value, the value of CBR/K value shall be adopted

<b>APPROXIMATE 'K' VALUE CORRESPONDING TO CBR VALUE FOR HOMOGENOUS SOIL SUBGRADES</b>									
<b>CBR Value (%)</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>7</b>	<b>10</b>	<b>20</b>	<b>50</b>	<b>100</b>
<b>K- Value (kg/Cm3)</b>	2.08	2.77	3.46	4.16	4.84	5.54	6.92	13.85	22

from IRC/58 of 1988, as detailed below: -

The recommendations of IRC:15-1981 shall be followed and K-Value of less than 5.10 kg/cm<sup>3</sup> tested on the sub grade shall not be permitted. The CBR/ K-value at top of sub grade shall be confirmed as instructed by the Engineer representing SMC.

**9** Contractors shall set up a laboratory at site before commencement of work at their cost for performing various tests and at least the following machines and equipment shall be provided therein.

- A) 1) Compressive strength testing machine (for cube tests) of minimum 130 tonne capacity, Calibration Certificate of recent calibration made shall be produced before commencement of work. Calibration shall be done every 1 year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days.

OR

Compressive strength testing machine (for cube tests) of minimum 130 tonne capacity, electrically operated conforming to IS-516 and duly calibrated every 1year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days.

2) Flexural test machine for testing of beams conforming to IS-516 and duly calibrated every 1 year. Testing machine should be maintained properly. In case of failure, the same shall be repaired or replaced within 2 days.

3) Minimum number of moulds for cubes should be 30 Nos.

4) Minimum number of moulds for beam should be 15 Nos.

- B) Set of Sieves  
C) Laboratory weighing balance of minimum 10 kg. Capacity, with set of standard weights from 1 gm to 5 kg.  
D) Aggregate drying equipment's M.S. Tray of 0.6 m x 0.45 m and Kerosene stove or electric hot plate.  
E) Equipment for testing of silt content in sand.  
F) Digital Display thermometer calibrated upto 200 degrees Celsius (for checking concrete temperature).  
G) Sieve shaker  
H) Kadappa stone platform of size 2.5 m x 0.90 m approx.  
I) Vibrating table of Size (1 m x 1m).  
J) other machines as may be directed by Engineer.

All the test records shall be meticulously maintained in the site office and made available as and when required.

Contractor must establish this laboratory within 15 days from the date of letter of acceptance of Contract. On failure to establish the laboratory in full a penalty of Rs.300/- per week or part hereof per equipment will be imposed till the Contractor procures the necessary equipment in good working condition.

**10.1** Deleted

**10.2** Whenever the cubes and beams are required to be sent to the Approved laboratory (As approved by the Engineer-in-Charge), the same shall be transported to the Approved

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Laboratory by the Contractors at their cost. The acceptance criteria for the test shall be as per I.S. 456. No payment for this will be made to Contractors.

The Contractors shall arrange to send the cubes and flexural beams to approved material testing laboratory at least two days before the date of testing of the cubes as well as beams failing which penalty of Rupees 500/- per set per day will be imposed and recovered from the Contractors bill. The charges for testing of cubes and beams shall be borne by the Contractors.

Quality Control in the field shall be exercised on the basis of compressive strength and workability. The maximum water cement ratio shall be 0.40.

- 10.3** In case the cube test for 28 days period fails, for any particular day's work, a minimum of 2 cores per 150cum. of concrete as per MoRT&H 5<sup>th</sup> Revision 2013 standards shall be extracted from pavement quality concrete at the locations selected randomly. The average value of test results of 3 cores shall be considered for deciding the concrete strength. The cores shall be extracted preferably from regular size of concrete slab panels (2 on either longitudinal side of the work).

If average strength fails, the entire quantity of pavement quality concrete poured on that day will not be paid.

- 10.4** In case the cube test for 28 days period fails, for any particular day's work, additional 3 cores shall be taken from that day's work and will be tested at Contractor's cost. The core will be mini. 150 mm. Dia. If it fails, no payment will be made.

- 11.1** The density of the compacted concrete shall be such that the total air voids are not more than 3%. The air voids shall be derived from the difference between the density of core and that of concrete cubes taken for the said day's work. The density shall be calculated as per Annexure-VIII. The average value of three cores of at least 150 mm diameter shall be considered.

- 11.2** All cores taken for density measurements shall also be checked for thickness. In case of doubt, additional cores may be ordered by the Engineer and taken at locations decided by him to check the depth or density of concrete slab without any compensation being paid for the same. Thickness of the slab at any point checked as mentioned above shall have minimum specified thickness as per drawing.

The cost of the cores and samples to be taken and their testing shall be borne by the Contractors. Cores of slab of M-40 shall be extracted and submitted in the government or NABL approved laboratory approved by the City Engineer. On the failure of compliance of this condition a penalty of Rs.500/- per set per day shall be imposed. However, in circumstances beyond Contractor's control, the matter of waiving penalty will be reviewed by the City Engineer.

- 11.3** In calculation of the density, allowance shall be made for any steel in cores. Cores shall be reinstated with epoxy mortar or as directed by the Engineer at the Contractor's costs. In case the cores are taken from the road already opened to traffic, the mix/material adopted for filling shall be such that it will develop the requisite

strength in a minimum period. The holes created by cores shall be so filled that these do not shrink. The core holes shall be reinstated within 24 hours of taking cores, failing which a penalty of Rs.1000/- per day shall be charged.

- 11.4** Core density test shall be carried out in accordance with relevant I.S. Codes. For testing of cores for strength, refer para 17.5.

**11.5 Sampling and Testing of Beams and Cubes Specimens**

At least three beams and three cube specimens, one set of three each for 7 day and 28-day strength tests shall be cast for every 150 cu.m part thereof) of concrete placed during construction. On each day's work, not less than three pairs of beams and cubes shall be made for each type of mix from the concrete delivered to the paving plant. Each pair shall be from a different delivery of concrete and tested at a place to be designated by the Engineer in accordance with the testing procedure as outlined in Clause 602.3.3. Groups of four consecutive results from single specimens tested at 28 days shall be used for assessing the strength for compliance with the strength requirements. The specimens shall be transported in an approved manner to prevent sudden impact causing fractures or damage to the specimen. The flexural strength test results shall prevail over compressive strength tests for compliance.

A quality control chart indicating the strength values of individual specimens shall be maintained for continuous quality assurance. Where the requirements are not met with, or where the quality the concrete or its compaction is suspect, the actual strength of the concrete in the slab shall be ascertained by carrying out tests on cores cut at the rate of 2 cores for every 150 cu.m of concrete. The average of the results of crushing strength tests on these cores shall not be less than 0.8 x 0.85 times the corresponding characteristic compressive strength of cubes, where the height to diameter ratio of the cores is two. Where height to diameter ratio is not two, necessary corrections shall be made in calculating the crushing strength of cubes in the following manner.

The crushing strengths of cylinders with height to diameter ratio between 1 and 2 may be corrected to correspond to the standard cylinder of height to diameter ratio of 2 by multiplying with the correction factor obtained from the following equation:

$$f = 0.11 n + 0.78$$

where f = correction factor and

n = height to diameter ratio

The corrected test results shall be analysed for conformity with the specification requirements for cube samples. Where the core tests are satisfactory, they shall have precedence for assessing concrete quality over the results of moulded specimens. The diameter of cores shall not be less than 150 mm.

- 11.6** If, however, the tests on cores also confirm that the concrete is not satisfying the strength requirements, then the concrete corresponding to the area from which the cores were cut should be replaced, i.e., at least over an area extending between two transverse joints where the defects could be isolated or over larger area, if necessary, as assessed by additional cores and their test results. The equivalent flexural strength at 28 days shall be estimated in accordance with Clause 602.3.3.2.

**PRE-CONCRETE CONSTRUCTION PHASE:**

- 12** If the contractors excavate certain portion of the road and fails to concrete the same within the stipulated time limit as per the programme, they will be required to reinstate this excavated road portion with bituminous layers as specified and directed by the Engineer. No payment will be made for such restoration.
- 13** The Contractors will have to obtain NOC from the Traffic Police Department well in advance for closing down the road or part thereof for the execution of the work. The work will have to be carried out in stages depending upon the permission granted by the Traffic Police Department for closure of the road or part thereof. The Contractors should therefore take this into account while quoting.
- 14** The Contractors should also note that they will have to modify, if required, the detailed programme submitted in the form of BAR Chart or PERT/CPM, considering the permission obtained from Traffic Police before actual starting of the work at site so as to complete the same in the stipulated Contract period.
- 15** Mix – design to give the target strength as required shall be prepared preferably in accordance with the relevant IRC/IS Specifications. The same shall be done by the contractors and checked by the Engineer. Whenever fresh lot of aggregate is used by the Contractor, the same shall be got checked. For this purpose, gradation analysis of course and fine aggregate shall be performed. The necessary correction shall be made in the mix design accordingly.
- 16** The mix – design shall preferably conform one of the methods specified in I.S. 10262 or IRC 44. However, preferably the mix design should be done as per details given in IRC-44 of 1976. “Tentative guidelines for cement concrete mix design”.
- 17** In addition to the ingredients mentioned in the bid for preparation of RMC for PQC the contractor shall add fibers may be steel fiber as per IRC: SP:46 or polymeric Synthetic Fibres within the following range of specifications: at the rate of 0.25% by weight of cementations material as directed by Engineer in charge. If PQC will found anywhere without such specified dosage of fibers, a penalty of Rs. 700/- per cumt. Of PQC laid without fibers will be imposed.

**Fibers:**

The fibers may be steel fiber as per IRC: SP:46 or polymeric Synthetic Fibres within the following range of specifications:

- Effective Diameter : 10 micron – 1.0 mm

- Length : 6-48 mm
  - Specific gravity : more than 1.0
  - Suggested dosage : 0.6-2.0 kg/cu.m (0.2 -0.6 % by weight of cement in mix).  
Usage will be regulated as stipulated in IRC:44/IS:456 or any other specialist literature.
- v. Water absorption : less than 0.45 percent
  - vi. Melting point of this fiber shall not be less than 160°C.
  - vii. The aspect ratio generally varies from 200 to 2000.
  - viii. These synthetic fibers will have good alkali and UV light resistance.

When fibers are used, the mix shall be so designed that the slump at paving concrete is  $25 \pm 15$  mm at site.

The minimum content of OPC / PPC cement to be used for DLC or PQC shall be as per MoRT&H 5<sup>th</sup> Revision 2013 & for other grades of concrete required for the subjected project, the same shall be as per table-5 of IS-456 (latest edition at the time of execution).

The cement to be used, shall be weighed (not on the standard bag basis) while mixing. No claim for excess cement used shall be entertained. If this minimum cement content is not sufficient to produce the strength of concrete specified in the drawing/design, it shall be increased as necessary without additional compensation under the contract, or else the fresh mix design shall be carried out till desired results are achieved.

- 18** The Granular Subbase should be adequately watered on the previous day and also two hours before starting lean concreting work so as to keep it in moist condition.
- 19** Double bulkheads for keeping the dowel bars in the proper alignment shall be provided as per drawing, and as directed by the Engineer. Tie bars should not fix in fresh concrete. Tie bars should be aligned exactly perpendicular to finished concrete surface of the slab by means of suitable device to be approved by the Engineer.
- 20** Dowel bars shall be Mild Steel rounds in accordance with details/ dimensions as indicated in the drawings and free from oil, dirt, loose rust or scale. They shall be straight, free from irregularities and the sliding ends sawn or cropped cleanly with no protrusions outside the normal diameters of the bar. The dowel bars shall be supported on double bulk- head or chairs in prefabricated joint assembly position as approved by the Engineer and as detailed in drawing of vol. IV prior to the construction of the slabs.

Unless shown otherwise on the drawing, dowel bars shall be positioned at the mid depth of the slab within the tolerance of  $\pm 20$  mm spaced equally along intended lines of the joints within tolerance of  $\pm 25$  mm. They shall be aligned parallel to the finished surface of the slab, to the centre line of the carriage way and to each other within the following tolerance.

For the bars supported on bulk – head prior to the laying of the slab.

All the bars in a joint shall be within  $\pm 4.5$  mm per 300 mm length of the bar

2/3rd of the bars shall be within  $\pm 3$  mm per 300 mm length of the bar.

No bar shall differ in alignment from adjoining bar by more than 3 mm per 300 mm length of the bar in either horizontal or vertical plane.

The Dowel bars shall be covered by a sheath of High-Density Polythene pipes of approved quality for half the length plus 25 mm for expansion joints. The sheath shall be tough, durable and of an average thickness, not less than 1.25 mm. The end portion of the sheath shall be plugged with suitable properly tight cap fitting.

- All excavations, trenches, obstructions, materials, etc., taken, kept or stacked on site in connection with the work should be sufficiently barricaded, as per the specifications mentioned in the item included for providing barricade, transverse and longitudinally and blinking lights should be provided at night as directed by the Engineer to prevent against any damage or danger to the traffic. The Contractors shall take all precautions to keep all the blinkers working throughout the night for the guidance of the traffic in the following manner. No extra payment will be made for blinkers. The Contractors should take this in account while quoting for the tender.

All blinkers shall be red in colour

At least two blinkers shall be provided across the direction of the traffic

The Contractors will take any other measures as may be directed by the Engineer from time to time for the safety of the traffic as well as concreted slab etc.

In the event of contractors not complying with the provisions of this clause, the Engineer may without notice to the Contractors put up the barricade as per the specifications or improve upon the same or improve the lighting or adopt such other measure as he may feel deem necessary and all the cost of such procedures as may be adopted by the Engineer shall be charged to the Contractors in addition to a penalty of Rs.10/- R.M. per day till compliance of these requirements.

## **22. CONCRETE BATCHING, MIXING, LAYING & COMPACTION**

23. The laying of M-10 concrete in pavement, will have to be carried out with proper form work only. It shall be ready mix concrete compacted with vibrators and shall have smooth surface. It should have proper cross profile as directed by the Engineer. The surface of M-10 CC shall be maintained smooth till overlaid by slab of M 40. The work will have to be carried out as directed by the Engineer.

- Curing shall be done by covering with Hessian cloth and sprinkling with water for 7 days or till the lean concrete is overlaid by M40. Slab, whichever is earlier, but for a minimum period of 48 hours.
24. M-10, M-15, M-20, M-40 & above concrete shall be carried out with ready mix concrete only.
  25. For the desired workability, the ready-mix concrete of M 40 will have a slump not more than **25 +/- 10** mm.
  26. Laying of PQC shall be carried out with slip form paving train of required capacity having electronic sensor device with auto dowel bar and Tie bar Insertion.
  27. The water cement ratio shall be strictly adhered to, as per the approved mix design and should be adjusted according to temperature variation during the day of casting of the slab, if found necessary. Care shall be taken to prevent the over vibration and appearance of water / laitance on top surface of the slab. If any excess water is noticed on the surface of the slab, the same shall be removed by moving Hessian cloth on top surface and the concrete mix shall be immediately rectified as directed.
  - 28 Deleted
  - 29 Deleted
  30. Whenever the needle vibrator is used, the mason must follow with a trowel and punch to the portions of concrete from where the needle vibrator is withdrawn to ensure that no hollow portion remains in the stiff mass of concrete. Plate vibrating shall also follow thereafter immediately.
  31. Concrete pavement must be in proper cross profile as per camber prescribed by the Engineer.
  - 32.1 After the final regulation of the surface of the slab, surface of concrete slab shall be brush – textured in a direction at right angles to the longitudinal axis of the carriageway.
  - 32.2 The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450 mm wide. The brush shall be made of 32-gauge tape wires grouped together in tufts spaced at 10 mm centres. The tufts shall contain an average of 14 wires and initially be 75 mm long. The brush shall have three rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 60 mm. long.
  - 32.3 The texture depth shall be determined by the sand patch test. The test shall be taken at least once in a week or whenever the Engineer considers it necessary, at times after constructions. 10 individual measurements of the texture depth shall be taken at least 2 Mtr. apart anywhere along the diagonal line across a lane width between points 50 M apart. No measurements shall be taken within 30 mm of the longitudinal edges of

the concrete slabs. The texture depth shall not be less than minimum required as per the table below, nor greater than a maximum average of 1.5 mm.

Time of Test	Minimum Texture Depth required
I) Not later than 6 weeks or before the road is opened to public traffic.	0.65 mm for an average of 10 measurements with no single measurements less than 0.60 mm.

**32.4** After the application of the brushed texture, the surface of the slab shall have a uniform appearance.

**32.5** Where the texture depth requirements are found to be deficient, the Contractor shall make good the texture across the full lane width over length as directed by the Engineer, by retexturing the hardened concrete surface in an approved manner.

**32.6.1** The following apparatus shall be used for testing the texture depth.

- i) A cylindrical container of 25 ml. internal capacity.
- ii) A flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, struck to one face, the reverse face being provided with a handle.
- iii) Dry natural sand with a rounded particle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.

**32.6.2** Method – The surface to be measured, shall be dried, any extraneous mortar and loose material removed and the surface swept clear using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over the surface, working the disc with its face kept flat in a circular motion so that sand is spread into a circular patch with the surface depressions filled with sand to the level of the peaks.

**32.6.3** The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from  $31000 / (D \times D)$  mm where D is the diameter of the patch in mm.

**33** It will be the responsibility of the contractor to give the required finish of riding surface by checking with the straight edge and wedge gauge and any deficiency observed shall be rectified as specified in the general specifications for Road Works.

**34** Initial curing shall strictly be done by covering with Hessian cloth and sprinkling with water over the concreted portion as soon as the concrete starts setting. Sprinkling of water be started just after brooming the concrete surface to avoid evaporation of water from the mix. Care should be taken not to disturb, the brushed surface texture.

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Further curing of concrete shall be done by casting 'vatas' in 1m x 1m grid over PQC with cement mortar in 1:6 proportion as directed, for a minimum period of 21 days from the date of casting of c.c. slab.

A penalty of Rs. 200/- per sq.m. per day will be levied for unattended / broken vatas, And for improper curing.

- 35** The vertical sides of concrete slab are required to be tarred with hot /cut-back bitumen of 80/100 grade before casting of the adjoining relevant bay. The channels should be erected perfectly in vertical position. Plastic sheet shall properly cover the gaps between two channels and the gaps at the bottom shall be properly sealed in C.M. for which no extra payment will be made.

The contractors shall have to cast man hole bay, water tables, water entrance bays etc. within 5 days from the date of casting slab, failing which a penalty of Rs. 500/- per set per day shall be levied on contractors.

- 37** The cement concrete slab pavement in M40 is required to be carried out strictly as per the drawing. As regards thickness no claims on account of additional thickness other than the specified, if provided, will be entertained.

**38** Deleted

**39** Deleted

- 40.** The joints shall be cut within 10 hours to a minimum depth of 90 mm or minimum 1/3<sup>rd</sup> depth of c.c. bay slab, as directed, failing which these will be got done at contractor's cost and penalty will be levied as directed by Engineer including withholding the payment of adjoining panels of the uncut joints for 5 years.

- 41.** The machine cut joints should be filled in immediately with thermocole as directed by the Engineer till regular dressing of joints is done. No Separate payment will be made for this work.

- 42.** The machine cut joints and expansion joints must be cleaned first by using Raking tool and then air blown with compressor, so as to remove dust, sand particles and foreign matter from the joints before filling them with cold applied liquid sealant of silicon.

The details of sealing compound and bituminous primer to be followed as per Annexure VII.

- 43.** No separate payment for restoring vattas before and after cutting of joints or damaged on any account shall be made. Such vattas shall be restored immediately by the contractors. After curing period is over, the vattas shall be removed thoroughly, without keeping behind any vatta impression and without damaging the surface texture of the slab.

- 44.** The contractors shall observe compliance of following requirement in respect of works of sealing of joint.

- 45.1 Deleted
- 45.2 Deleted
- 45.3 Deleted
- 45.4 Deleted
- 45.5 The joints cut and cleaned shall be got certified from the Engineer before filling with sealing compound as per the specification for sealing of joints in rigid pavements. The spilled over sealing compound if any shall be removed immediately.
46. The regularity of the surface of the slab shall comply with the requirement of following clause.
- 46.1 Compliance with the requirements of this clause for surface regularity shall be measured using an approved 3 m long straight edge and wedge in such a way as to reveal any and all irregularities. The maximum permitted number of surface irregularity of 4 mm and 7 mm in a length of 300 m shall be 20 & 2 numbers and such irregularities shall be properly recorded in the register.
- 46.2 Longitudinal irregularity shall normally be measured along any line or lines parallel to the edge of the slab.
- 46.3 Transverse irregularity shall normally be measured along any line with the straight edge placed at right angles to the center line of the road.
47. If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerance shall be demolished and reconstructed at the Contractor's expense.
48. There shall be a defect liability period of 5 years (60 months) for c.c. pavement

Any defects in concrete pavement occurring during this defect liability period shall be repaired/ replaced by the contractor in compliance with IRC-SP:83 free of cost. Defects of the concrete pavement shall be identified in compliance with IRC-SP:83 by joint site visits of Contractor along with representative of SMC after every monsoon during defect liability period. Defects in concrete pavement thus identified by the joint visit shall be repaired/ replaced in compliance with methods stipulated in IRC-SP:83 within 2 months of identification of such defects during this defect liability period of 7 years.

PQC panels having crack width up to 1.5mm does not require any repair. Panels having crack width up to 3mm needs to be repaired with Epoxy grouting or any other suitable method as stipulated in IRC-SP:83.

Whereas PQC panels having crack width exceeding 3mm and d (depth of crack)  $> D/2$  (D = depth of slab) are considered as structural cracks and shall be repaired/ replaced as per IRC-SP:83. 50% payment shall be withheld for all panels identified as defective (during this defect liability period) due to structural cracks or

any other distress (other than crack width upto 3mm) requiring repairs as per IRC-SP:83. However, for cracks in Manhole (M.H). bays, entire cost of M.H. bays shall be withheld. The contractor needs to repair/replace & maintain these defective panels during this defect liability period. The withheld amount shall be released on successful completion of repairs/ replacement of these defective panels and its maintenance up to the defect liability period. In case the contractor fails to comply the above, the withheld amount will be considered as penalty and hence will be forfeited. It is obligatory on the part of contractors to take care of such defective panels during the guarantee period. In case of replaced slab, a defect liability period of 7 years shall be enforced from the date of completion of such works. During the defect liability period, dressing of joints complete in all respect shall have to be done free of cost at least once in a year preferably in the month of April or May or as directed by the engineer under supervision of owner. During the initial 2 years of defect liability period contractor shall maintain the thermoplastic paint in visible condition. All eroded and iced/abraded pavement marking shall be redone at contractors cost during this period. Every year during joint inspection pavement Cracking shall also be inspected and attended by contractor. If the Contractor fails to comply with the above conditions, the note of the same will be taken while evaluating the tenders for c.c. road works in future.

- 48.1** It will be the responsibility of the contractor to arrange for a joint inspection before monsoon every year after completion of the work till the expiry of defect liability period and also at the fag end of the defect liability period. Further, if the contractor fails to do so, the observations made by the staff during site inspection shall be considered for the purpose of noting the defects.

**49.** Deleted

The Contractor shall obtain and maintain an electric connection at their cost till expiry of Contract period at the site for lighting as well as for operating machinery within 15 days from the date of receipt of permission for erection of site office from the respective ward office failing which a penalty of Rs.300/- per day will be levied and recovered.

The Contractors shall obtain and maintain a telephone at site at their cost till expiry of the contract period within 15 days from the date of erection of site office, failing which a penalty of Rs.300/- per day will be levied and recovered. The tenderers should note the change in description of the specifications of the water proofing paper provided as a separation membrane, between concrete pavement slab and the sub-base in the relevant item.

After completion of the work, the Contractors shall submit three sets of completion drawings showing therein the details of work executed including the details of SWD and their diameters, water mains laid, location of ducts, manholes and water entrances etc., as directed by the City Engineer. Such plans shall be mounted on canvas cloth. The completed work shall be handed over to all the concerned departments of SMC along with the respective zone offices with necessary plans after completion of the work.

The Contractor shall maintain records, jointly with the Engineer's representative, of the day-to-day activities of work in the detailed Performa prescribed by the Engineer from time to time, for documenting the quantum of work, the results achieved monitoring and shall strictly follow the Quality Assurance procedures laid down for grant item.

If any contractor fails to carry out work, the same will be got executed at his risk and cost, through other agencies.

The works shall be carried out at least at various places at a time simultaneously if necessary, so as to complete the work in stipulated time.

The frame and cover of manholes, inspection chambers etc. shall be as per the prescribed drawings and specifications available with office of City Engineer.

Contractor shall procure and maintain one Pentium IV computer and a printer in good working condition on work site at their cost till expiry of contract period within 15 days from the date of erection of site office, failing which a penalty of Rs.1000 per day will be levied and recovered. The work carried out every day including consumption of R.M.C., thickness of layers etc. as directed by the Engineer shall be recorded in the computer and reported on hard copy to Engineer in Charge twice a week. If the computer/printer goes out of order, a penalty of Rs.1000/- per day will be imposed till the Contractor repairs the computer. Further, the hand written reports shall be submitted till the computer/printer gets repaired.

The Contractor shall procure RMC from the RMC plant approved by SMC only. Ready Mix concrete prepared and transported will be as per relevant IS 4926.

Ready mix concrete will be brought to the site from RMC plant by transit mixers/dumper/tripping trucks (agitators).

Every transit mixer /dumper/tripping truck of concrete will carry delivery challan, mentioning the minimum following details: -

Name of Manufacturer and Depot

Serial No. of challan

Date

Truck No.

Name of Contractor.

Location of Contract work

Grade of Concrete

Time of loading

Quantity of concrete

Temperature of RMC & at site:

A computerized print out showing details of ingredients of ready-mix concrete including admixture viz., the actual weight of each ingredient, required weight of each ingredient as per mix design etc. shall invariably be obtained with each transit mixer carrying RMC on site. The computerized sheet shall be signed by the site in charge and contractor's representative and shall be presumed as a record on the site.

When the truck arrives on site, the drum should always be speeded to about 10 to 15 rev/min, for at least 5-10 minutes, to make sure that the concrete is thoroughly mixed and uniform, before discharge.

As regards testing of workability, following procedure be followed –

After making sure that the concrete has been uniformly mixed, take a sample from the first 0.5 cu.m. of concrete discharge, and do a slump (or compacting factor) test on the sample. If the result complies with the specified requirements, then the load should be accepted. If the results are beyond limits, a further sample should be taken from the second 0.5 cu.m. of the discharge, and if this is satisfactory, the load should be accepted, if not, the concrete load shall be rejected, as the same is not as per the specification range. The specified slump is 50 mm while carrying out above tests, it may vary by 10 mm as per IS 4926-1976.

All taxes/duties etc. will be borne by the Contractors and not by the SMC

No extra payment will be made for the use of admixtures

The defect liability period of 5 years will be the responsibility of the main tenderer.

**Table-1: Minimum Test Frequencies for Quality Control of Concrete Road Construction**

Item	Test Check Control Criterion		Frequency
<b>APPROVAL OF SOURCE OF SUPPLY MATERIAL</b>			
Cement	Physical and Chemical Test	IS-8112	Once for each source supply for approval of source and subsequent when warranted
Coarse and Fine Aggregate	-do- (Including soundness and alkali reactivity)	IS-383	--do--
Water	Chemical Test	IS-456	-- do --

**DURING CONSTRUCTION:**

**MATERIAL:**

Cement	Strength	IS-8112	For each lot of cement received
Cement 53 OPC	Physical Test	IS-8112	Once in a every two months
	Chemical Test	IS-8112	Once before its use
PPC conforming to IS 1489 (Part-I)	strength and all other properties	IS-1489 (Part-I)	As per above
Coarse and Fine Aggregate	Gradation received	IS-383	For each lot of aggregate

	Moisture Content	--do--	Regularly as required subject to a minimum of 2 test per day
	Flakiness Index	--do--	--do--
	Elongation Index	--do--	--do--
Concrete	Workability		For each load
	Concrete Strength		Cube Samples, as specified for each age of 7 day and 28 days (for every day's work)

**Table-2 – Additional Quality Control Criteria and Tolerances**

Position	Criterion	Tolerance
Cement concrete pavement	Quality Concrete grade M-40 and above	Tolerance level for characteristic strength Assessment: 1 in 15
	Workability 25 mm, (slump) maximum	+/- 10 mm

**NOTES:**

The provisional approval gives no right to run a RMC plant upon ground which is not the property of RMC plant owner.

The RMC plant owner shall obtain all the prevailing necessary statutory permissions/licenses etc. from various Govt/semi-Govt./SMC authorities under various Acts applicable to RMC plant.

Measurement of PQC will be in Cum and Rates shall be as indicated in BOQ. Payment for PQC Item shall be as follows:

- (A) 80% of the payment for defect free PQC panels as decided by the Engineer representing by SMC shall be made after completion of laying of PQC.
- (B) 90% of the payment for defect free PQC panels as decided by the Engineer representing by SMC shall be made after achieving 28<sup>th</sup> days characteristic strength of cube.
- (C) For 100% payment of defect free PQC panels as decided by the Engineer representing by SMC shall be made after completion of this item in all respects and submission of all necessary test results.

All cracks in PQC panels (both surface & structural) shall be repaired and maintained by the contractor till the completion of defect liability period without any extra payment as directed by the Engineer representing SMC.

**Design of Rectangular Slabs**

The analysis carried out in these guidelines is for square slabs. However, if a rectangular slab is selected, the design has to be done in two stages. The length of the longitudinal edge (L) has to be considered for transverse cracking analysis. The length of the transverse edge (W) has to be considered for longitudinal cracking analysis. This approach can be used if the aspect ratio (longer edge length/shorter edge length) is less than 1.2. If the

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slab size selected for the design is of a rectangular slab of size L x W, then the transverse cracking and longitudinal cracking analysis have to be carried out for two different sizes (L and W respectively). An excel file is included in the CD for design of rectangular slabs. The stresses for transverse cracking analysis and longitudinal cracking analysis have to be copied from the design excel sheets of the two square slab sizes; Land W.

### **Joint Activation Requirement in SSCP**

In the case of conventional jointed plain concrete pavements, the joint grooves are cut at regular intervals so that the joints (full depth shrinkage cracks) form at those locations. This prevents formation of random cracks. However, all the places where joint grooves are cut do not form into a full depth crack. Only if the crack occurs at the joint groove, then it is called an active joint as it acts as a joint only then. If the joint groove is not active, then it is not a joint (active joint) and hence the effective length of the slab will be more than the length considered in the design. Hence, the stress could be more than anticipated (due to longer span), leading to random cracking in the slabs due to wheel loads (in combination with the temperature stresses). Higher the percentage of active joints, better will be the performance of the concrete pavement.

In the case of SSC pavements, the percentage of active joints is typically 60-70 % compared to a conventional concrete pavement which has nearly 90-95% active joints (Chen et al., 2022). Considering this, extra care has to be taken to increase the percentage of active joints. One such method of activating more joints is by allowing a loaded truck to ply on the pavement section with the wheels placed over the longitudinal joint and then along the mid-width of the slabs after 5-7 days of curing. This process can improve joint activation as the concrete does not attain full strength in 5 to 7 days and the thickness of the PQC layer below the joint groove cut is only 2/3rd of the slab thickness.

### **Joint Sealant Requirements**

In SSCP, joint sealant is generally not necessary as the joint groove width is less than 5 mm as there is only a single saw cut with a blade of width 3-4 mm. However, if the project site is in a high rainfall area, suitable joint sealant may be used based on the experience of the engineer concerned.

### **Design of Dowel Bars**

Dowel bars are provided in SSC pavements only for construction joints. The design of the bars shall be done as per IRC:58 guidelines. Considering the smaller sizes of the slabs with closer spacing between the longitudinal joints used in SSCP, the number and spacing of the dowel bars shall be selected so that adequate cover is available to the bars from the longitudinal joints (vertical crack propagation at the joint grooves). So, a minimum cover of half the slab thickness may be provided for the dowel bars.

IRC:SP:140-2024

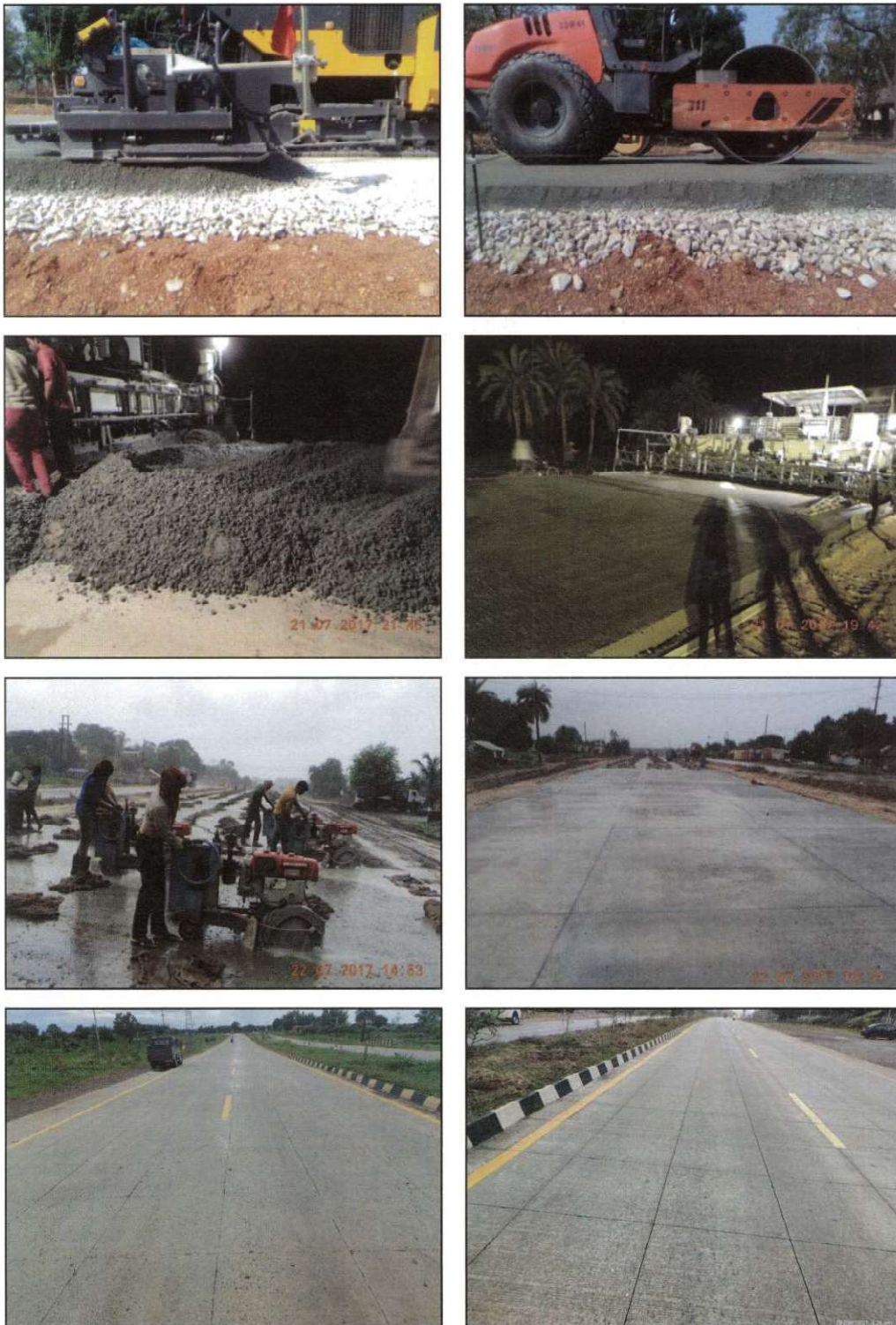


Fig. C-2 Different Operations of Construction of SSC Slab over DLC Layer

***Item No 6.04 Providing and placing in position high TMT bar Fe 500 for R.C.C work***

***6.04 Providing & fixing IS Mark TMT Bar FE 500D reinforcement for R.C.C. work incl. bending, binding & placing in position etc. comp. Upto G.L./P.L.***

For reinforced cement concrete (RCC) works, the reinforcement/intentioned steel as the case may be shall consist of the following grades of reinforcing bars.

**TABLE 1000-3**

<b>Grade Designation</b>	<b>Bar Type conforming to governing IS Specification</b>	<b>Characteristic Strength fy (MPa)</b>	<b>Elastic Modulus GPa</b>
S 500	IS: 1786 High Yield Strength Deformed Bars (HYSD)	500	200

Other grades of bars conforming to IS: 432 and IS: 1786 shall not be permitted.

All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work.

Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

***Item No6.05 Supplying and filling fine sand (Pana/Stone Dust/Crush sand)***

***6.04 Supplying and filling fine sand (Pana/Stone Dust/Crush sand) in 25/75 mm (Avg.) compacted thickness over the base including necessary compaction, watering etc. complete. item includes levelling by using mini rollar/plat vibrator machine and as per details in tender specification & as directed by engineer in charge.***

**1 Materials**

Fine aggregate shall consist of natural or crushed sand conforming to IS 383: 1970.

Sand shall be natural sand, clean, well graded, hard, strong, durable and gritty. Sand particles should be free from injurious amounts of dust, clay, kankar, nodules, soft or flaky particles of shale, alkali, slats, organic matter loam, mica or other deleterious substances and shall be got approved from the Engineer in charge. The sand shall not contain more than 3% silt as determined by field test, if necessary, the sand shall be washed to make it clean.

Foreign materials limitations: (in accordance with IS 383: 1970 table 1)

The percentage of deleterious substances in sand used shall not exceed the following:

<b>Sr.No.</b>		<b>Percentage by Weight</b>	
		<b>Uncrushed</b>	<b>Crushed</b>
1	Material finer than 75micron IS sieve	3	15
2	Shale	1	-
3	Coal and lignite	1	1

4	Clay lumps	1	1
5	Total of all above substances	5	2
Items 1 to 4 for un-crushed and items 3 and 4 for crushed sand.			

Gradation of fine aggregates:

(In accordance with table 4; clause 4.3 for fine aggregates of IS 383: 1970.)

Unless otherwise directed or approved the grading of sand shall be within the limits indicated hereunder:

	Percentage passing for	Percentage passing for	Percentage passing for	Percentage passing for
IS sieve designation	Grading	Grading	Grading	Grading
	Zone I	Zone II	Zone III	Zone IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600micron	15-34	35-59	60-79	80-100
300micron	5-20	8-30	12-40	15-50
150micron	0-10	0-10	0-10	0-15

Where grading fails outside the limits of any particular grading zone of sieves, other than 600micron IS sieve by local amount not exceeding 5%, it shall be regarded as failing within the grading zone. This tolerance shall not be applied to percentage passing any other sieve size on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to grading zone IV shall not be used for reinforced concreting works.

Fineness Modulus:

Fine sand: 2.2 to 2.6

Medium sand: 2.6 to 2.9

Coarse sand: 2.9 to 3.2

The fineness modulus is determined by adding the cumulative percentage retained on the following IS sieves sizes (4.75mm, 2.36mm, 1.18mm and 60 by 100).

In general, the fineness modulus of sand shall not be less than 2.5 and shall not exceed 3.0. A sand having a fineness modulus of more than 3.2 will be unsuitable for making satisfactory concrete.

### Workmanship

Fine sand (Pana) shall be supplied to work site and stacked at suitable place. It shall be got approved by Engineer-in-charge. Fine sand (Pana) shall be filled in compacted thickness of

150 mm. It shall be levelling by using vibratory plates compacted machine and as directed by engineer in charge

### ***Item No 6.06 Providing and fixing in the carriageway Interlocking concrete pavers unshaped***

***6.06 Providing and fixing in the carriageway Interlocking concrete pavers uni-shape (monolithic single layer precast concrete blocks) of any specified colour / size & shape, with approved pattern etc. of 100 mm thick having average crushing strength of 50 N/mm<sup>2</sup> on average thickness of 45 mm uniformly graded river sand cushioning with properly compacted with mechanical compactor with required level, grade and camber etc. complete as directed by Engineer-In-charge. (Excluding Sand bed)***

Paver blocks shall be procured from SMC's approved manufacturer.

### **TECHNICAL SPECIFICATION FOR PAVER BLOCKS**

The pattern and colour of paver block shall be as per the prior approval and direction of engineer in charge.

Paver block to be used shall be as per technical specification as specified in IS 15658-2006.

### **1.0 RAW MATERIALS**

#### **Cement**

The cement used in the manufacture of high quality precast concrete paving block shall be conforming to IS 12269 (53 grade) ordinary Portland Cement or IS 8112 (43 grade ordinary Portland cement). The minimum cement content in concrete used for making paver blocks should be 310 kg/Cu.M. And the upper limit of cement shall not be more than 425kg/Cu.M. Entire quantity of cement required to manufacture paving blocks shall be procured by contractor at his own cost.

#### **Aggregates**

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials which, apart from the grading requirements comply with IS 383-1970. The fine aggregates used shall contain a minimum of 25% natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay and shall be free from deleterious salts and contaminants.

#### **Water**

The water shall be clean and free from any deleterious matter. It shall meet the requirements stipulated in IS:456-2000.

#### **Other materials**

Any other material/ingredients used in the concrete shall conform to latest IS specifications.

### **PAVER BLOCKS CHARACTERISTICS**

The concrete pavers should have perpendicular ties after release from the mould and the same should be retained until the laying.

The surface should be of anti-skid and antiglare type.

The paver should have uniform chamfers to facilitate easy drainage of surface run off.

The pavers should have uniform interlocking space of 2 mm to 3 mm to ensure compacted sand filling after vibration on the paver surface.

The concrete mix design should be followed for each batch of materials separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The pavers shall be manufactured in single layer only.

Skilled labour should be employed for laying blocks to ensure line and level for laying, desired shape of the surface and adequate compaction of the sand in the joints.

The pavers are to be skirted all round with kerbing using solid concrete blocks of size 100 mm x 200 mm x 400 mm or as directed by the Engineer. The kerbing should be embedded for 100 mm depth. The concrete used for kerbing shall be cured properly for 7 days minimum.

### **Laying of Paver Blocks**

#### **Priming**

It will be responsibilities of the Contractors to ensure that the manhole/pipeline cable trenches/circular drainage system etc. raised to driveway level using the requisite materials as per instruction of Engg. The areas of potholes/deep depressions at the isolated locations also have to be filled up before laying the paver blocks. No extra pavements will be made for this purpose.

It will be the responsibility of the Contractors to ensure that undulations on the paver blocks are eliminated after the traffic is allowed on it. Proper slope for drainage of water needs to be ensured by the Contractor. All necessary materials, tools, tackles are required to be arranged by the Contractor.

#### **Bedding sand course**

The bedding sand shall consist of a clean well graded sand passing through 4.75 mm sieve and suitable for concrete. The bedding should be from either a single source or blended to achieve the following grading.

<b>In sieve size</b>	<b>% Passed</b>
9.52 mm	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm	60-100
600 microns	25-60
300 microns	10-30
150 microns	5 – 15
75 microns	0 – 10

Contractor shall be responsible to ensure that single-sized, gap graded sands or sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp not rounded as sharp sand possess higher strength and resist the migration of sand from under the block to less frequently areas even though sharp sands are relatively more difficult to compact than rounded sands, the use of sharp sands is preferred

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for the more heavily trafficked driveways. The sand use for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence.

The sand shall be of uniform moisture content and within 4% - 8% when spread and shall be protected against rain when stock piled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be of 45 mm and within +/- 5 mm. Thickness variation shall not be used to correct irregularities in the base course surface.

The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or screeded sand left overnight shall be loosened before further laying of paving blocks take place.

Sand shall be slightly screeded in a loose condition to the predetermined depth only slightly ahead of the laying of paving unit.

Any depressions in the screeded sand exceeding 5 mm shall be loosened, raked and rescreened before laying of paving blocks.

### **Laying of interlocking Paver Blocks**

Paver blocks shall be laid in herringbone laying pattern throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not be permitted in other than approved locations.

Paver blocks shall be placed on the uncompacted screened sand bed to the nominated laying pattern, care being taken to maintain the specified bond throughout the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving blocks are permitted or edge blocks may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine.

Paver blocks shall be placed to achieve gaps nominally 2 to 3 mm wide between adjacent paving joints. No joint shall be less than 1.5 mm not more than 4 mm. Frequent use of string lines shall be used to check alignment. In this regard the "laying face" shall be checked at least every two meters as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with.

In each row, all full blocked shall be laid first. Closure blocks shall be cut and fitted subsequently. Such closer blocks shall consist of not less than 25% of a full block.

To infill spaces between 25 mm and 50 mm wide concrete having screened sand, coarse aggregate mix shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used.

Except where it is necessary to correct any minor variations occurring in the laying bond, the paver blocks shall not be hammered into position. Where adjustment of paver blocks necessary care shall be taken to avoid premature compaction of the sand bedding.

**Initial Compaction**

After laying the paver blocks, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than Two (2) passes of a suitable plate compactor.

The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving blocks. Prior to compaction all debris shall be removed from the surface.

Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one metre of the laying face. Compaction shall continue until lipping has been eliminated between adjoining blocks. Joints shall then be filled and recompactd as described in Cl. 3.5.

All work further than one metre from the laying face shall be left fully compacted at the completion of each day's laying.

Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced.

Sufficient plate compactors shall be maintained at the paving site for both bedding compaction and joint filling.

**Joint filling and final compaction**

As soon as possible after compaction and in any case prior to the termination of work on that day and prior to the acceptance of vehicular traffic, sand for joint filling shall be spread over the pavement.

Joint sand shall pass a 2.36 mm (No.8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits.

<b>In sieve size</b>	<b>% Passed</b>
2.36 mm	100
1.18 mm	90-100
600 microns	60-90
300 microns	30-60
150 microns	15-30
75 microns	10-20

The Contractor shall supply a sample of the jointing sand to be used in the contract prior to delivering any such materials to site for incorporation into the works. Certificates of test results issued by a recognized testing laboratory confirming that the samples conform to the requirements of this specifications shall accompany the sample.

The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) Pass by the plate vibrator and joints refilled with sand to full depth. This procedure

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shall be repeated until all joints are completed filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted.

Both the sand and paver block shall be dry when sand is spread and broomed into the joints to prevent premature setting of sand.

The difference in level (lipping) between adjacent blocks shall not exceed 3 mm with not more than 1% in any 3 m x 3 mm area exceeding 2 mm. Pavement which is deformed beyond above limits after final compaction shall be taken out and reconstructed to the satisfaction of the Engineer.

### **Edge Restraint**

Edge restrains need to be sufficiently robust to withstand override by the anticipated traffic, to withstand thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside of the laying course.

The surface course should not be vibrated until the edge restraint, together with any bedding or concrete haunching, has gained sufficient strength. It is essential that edge restraints are adequately secured.

### **Sampling and Testing Procedures for Paver Blocks**

#### **Sample Size**

Internal – Average of minimum 3 samples per 5000 blocks – for paver block manufacturers.

External – Minimum 2 blocks per 10000 blocks. Average of minimum 8 blocks per site – for captioned contractors.

#### **Sampling for Testing**

Sampling for testing of paver blocks shall be done in accordance with Appendix-A

#### **Compressive Strength: -**

Testing for compressive strength shall be undertaken in accordance with Appendix-B. The average compressive strength of the 80 mm thick paver block tested shall be 50 N/Sq mm and average compressive strength of the 60 mm thick paver blocks tested shall be 45 N/Sq mm.

#### **Water Absorption: -**

Testing for water absorption shall be in accordance with IS 2185:1979: Part I (Specifications for concrete masonry blocks) Appendix C

**Abrasion Test: -** Testing for abrasion shall be carried out in accordance with IS 15658-2006

### **Appendix –A**

#### **Sampling of Paver Blocks**

#### **Method of Sampling**

Before laying paver blocks, each designated section comprising not more than 50000 blocks, shall be divided into ten approximately equal groups. Three blocks shall be drawn from each group.

### **Marking and Identification**

All samples shall be clearly marked at the time of sampling in such a way that the designated section of Part thereof and the consignment represented by the sample, are clearly defined.

The sample shall be dispatched to the approved test laboratory taking precaution to avoid damage to the paving in transit. Protect the paving from damage and contamination until they have been tested. The samples shall be stored in water at  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for 24 hours prior to testing.

## **Appendix – B**

### **Procedure for Testing of Compressive Strength for Paver Blocks**

#### **Reference: BS 6717 Part I (1993) Specification for Paver Blocks**

**B-1 Testing Machine:** The testing machines shall be of suitable capacity for the test and capable of applying the load at the rate specified. It shall comply, as regards repeatability and accuracy with the requirements of relevant IS specification.

**B-2 Procedure:** The sample specimens shall be tested in wet condition after being stored at least 24 hours, in water maintained at a temperature of  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$  before the specimens are submerged in water, the necessary area shall be determined.

The plates of the testing machine shall be wiped clean and any loose grit or other material removed from the contact faces of the specimen. Plywood nominally 4 mm thick, shall be used as packing between the upper and lower faces of the specimen and the machine plates, and these boards shall be larger than the specimen by a margin of at least 5 mm at all points. Fresh packing shall be used for each specimen tested. The specimen shall be placed in the machine with the wearing surface in a horizontal plane and in such a way that the axes of the specimen are aligned with those of the machine's plates. The load shall be applied without shock and increased continuously at the rate of approximately 15 N/sq.mm per minute until no greater load can be sustained. The maximum load applied to the specimen shall be recorded.

**B-3 Calculation of Corrected Strength:** The compressive strength of each block specimen shall be calculated by dividing the maximum load by full cross section area and multiplying by an appropriate factor.

Thickness and Chamfer Correction Factors

For Compressive Strength

Work Size Thickness in mm	Correction Factors	
	Plain	Chamfered Block

	<b>Block</b>	
60	1.00	1.06
80	1.12	1.18
100	1.18	1.24

#### **B-4 Compressive Strength Calculation:**

The average corrected compressive strength for the designed block section shall be calculated.

#### **APPENDIX –C**

##### **Method for the Determination of Water Absorption**

The test specimens shall be completely immersed in water at room temperature for 24 hours.

The specimens shall then be weighed, while suspended by a metal wire and completely submerged in water

They shall be removed from the water and allowed to drain for one minute

Visible surfaces water being removed with a damp cloth and immediately weighed

Subsequent to saturation, all specimens shall be dried in a ventilated oven at 100 to 115oC for not less than 24 hours and until two successive weightings at intervals of 2 hours show an increment of loss not greater, than 0.2 percent of the last previously determined mass of the specimen.

Calculate the absorption as follows:

$$\text{Absorption, kg/m}^3 = \frac{A-B}{B-C} \times 10000$$

$$\text{Absorption percent} = \frac{A-B}{B} \times 100$$

Where A= wet mass of unit in kg

B= dry mass of unit in kg. and C= suspended immersed mass of unit in kg.

#### **APPENDIX –D**

##### **Durability of paver blocks**

It is observed that the paver blocks get eroded due to wear & tear of traffic, in spite of passing in abrasion testing. It is therefore the mandatory requirement that the paver blocks should be durable and not adversely affected due to abrasion at least during the defect liability period of 5 years. In case of such defect observed due to abrasion or any other reason, such paver blocks are required to be replaced free of cost by the contractors.

Measurement for this item shall be in Sqm and rates for the complete item as per the item description and specification shall be as indicated in the BOQ

***Item No 6.07 Providing and fixing C.C.M-20 grade pre-cast Vacuum pressed finished surface kerb stones***

***6.07 Providing and fixing C.C.M-20 grade pre-cast Vacuum pressed finished surface kerb stones of approved design including the cost of form work and mould (as directed by engineer incharge),curing etc.complete.The rate shall also include for erecting and fixing the pieces in position with necessary equipments and materials and include the flush pointing in CM(1:2) for all joints of the kerb stones. (Sample must be approved)***

(i) M-20 grade Precast/ cast-in-situ kerbs for Median as per drawing and as directed by. Engineer in-charge

(A) 600(L)\*300(H)\*125(Thick) precast vacuum press kerb stone

(B) 300(L)\*480(H)\*150(Thick) precast vacuum press kerb stone

(C) 600(L)\*450(H)\*125(Thick) precast vacuum press kerb stone

(D) 600(L)\*375(H)\*100(Thick) precast vacuum press kerb stone

- The manufacturing company must be an ISO 9001 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The Kerbstone material must be tested at the manufacturer's laboratory before dispatch for: Bending strength, Water absorption, and dimensional accuracy. Internal test report needed with every supply.

**Testing to be carried out in accordance with EN 1340**

(ii) in size M-20 grade pre cast Kerbs for Fixing as per drawing purchased from SMC's approved manufacturers and as directed by Engineer with all leads, lifts etc. complete.

Cement concrete precast kerb shall be procured from SMC's approved manufacturer.

Shall be in conformance with Section 1700 of Specification of road and bridge work (MORT & H).

Measurement for this Item will be in RM and rates for the Item complete in all respects as per the instructions of Engineer representation SMC will be as indicated in BOQ.

Sr.	Parameters	Minimum Requirements
1.	Percentage Water Absorption	Not over 6%
2.	Tolerance in size (length + breadth)	±1.5mm
3.	Tolerance in Thickness of block	± 4mm

- The face of the kerb shall not exhibit defects such as cracking or flaking when examined.
- For faces described as flat and edges described as straight, the permissible deviations on flatness and straightness are given in **Table 1**.

**Table 1-** Permissible deviations of flatness and straightness

Length of gauge mm	Permissible deviation of flatness and straightness Mm
300	±1.5
400	±2.0
500	±2.5
800	±4.0

- Bending Characteristic of Kerb as per Table 2

**Table 2- Bending Characteristic**

Characteristic bending strength MPa	Minimum bending strength Mpa
4.5	4.0

- The manufacturing company must be an ISO 9001 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The Kerbstone material must be tested at the manufacturer's laboratory before dispatch for: Bending strength, Water absorption, and dimensional accuracy. Internal test report needed with every supply.

Supply of Kerbstones, manufactured on Vacuum wet Press Machine with hydraulic pressing of wet concrete mixture to a minimum of 400 tons with simultaneous vacuuming, using ECO filters. Anddeveloping a pimple finish.

Supply of Water drain channel, manufactured on Vacuum wet Press Machine with hydraulic pressing of wet concrete mixture to a minimum of 400 tons with simultaneous vacuuming, using ECO filters.

**Testing to be carried out in accordance with EN 1340**

***Item No 6.08 Providing and fixing in position Readymade vaccum wet press kerb block***

***6.08 Providing and laying/fixing cement concrete cast-in situ/Precast kerb in M-20 grade as per drawing and as per details in tender specification, Purchsed from SMC's approved manufactures list. Setting in line, level and in truly vertical position, including filling joints 10mm width in C.M. 1:1 (1 Part of cement 1 part of coarse sand) smooth pointing in C.M. 1:1 (1 Part of cement : 1 Part of stone dust) including watering, test required to be carriedout etc. complete and as directed by Engineer-incharge. including all leads, lifts, loding & unloding, watering,labour, tests required to be carried out, machinery, equipments required to execute this item etc. complete. (H- Height, W-width T-thickness)***

**(A) Size in mm (H 775 X W 300 X T190)**

Refer description mentioned in Item No. 7.07

***Item No 6.09 Providing and fixing in position Readymade C.C. kerb block***

***6.09 Providing 100 mm thick readymade C.C. kerb of strength M20 (Size 300 x 380 mm) purchased from S.M.C.'s approved paver block manufacturer and setting in line, level and in truly vertical position, including filling joints 10mm width in C.M. 1:1 (1 Part of cement 1 part of coarse sand) smooth pointing in C.M. 1:1 (1 Part of cement : 1 Part of stone dust) including watering, test required to be carried out etc. complete and as directed by Engineer-in-charge). including watering, labour, tests required to be carried out, machinery, equipments required to execute this item etc. complete.***

Precast Concrete Kerb shall be procured from SMC's approved manufacturer.

Shall be in conformance with Section 1700 of Specification of Road and Bridge work Execution of this Item shall be in compliance with the Item description and as per the direction as per the Engineer representing SMC, all complete.

Measurement for this Item will be in RM and rates for the Item complete in all respects as per the instructions of Engineer representing SMC shall be as indicated in BOQ.

**Specifications for 80 mm thick Interlocking Concrete Paving Blocks with ISI mark (IS15658:2006)**

Supply of High Strength high finish Interlocking Concrete paving blocks with ISI mark (IS 15658:2006) in single layer production with following Specifications.

<b>Sr.</b>	<b>Parameters</b>	<b>Minimum Requirements</b>
1.	Percentage Water Absorption	Average not over 6%
2.	Compressive strength	Average not less than 500 Kg/cm <sup>2</sup>
3.	Tensile Splitting Strength (as per EN 1338)	Average not less than 3.6Mpa
4.	Average wear in Thickness-Abrasion	Conforming to Grade 'H' of EN 1338
5.	Tolerance in size (length + breadth)	± 1.5mm
6.	Tolerance in Thickness of block	± 3mm
7.	Colours	UV Light resistant fast colours from Lanxess only to be used

- The blocks must be manufactured on Vibropress type machine only. The manufacturer must demonstrate feeding of material into the machines by automatic batching plants with capacity of min 30m<sup>3</sup>/hr.
- The manufacturing company must be an ISO 9001:2008 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The blocks will be made using wear resistant materials in the face mix as specified by the architects.

- The colours of the blocks (wearing layer) will be as selected by the architects.
- The blocks must be cured in controlled environment to ensure efflorescence free material.
- The manufacturer must have in house testing laboratory to carry out all testing including Compressive strength testing, Tensile strength testing, Water absorption, abrasion resistances.

***Item No: 6.10 Providing and fixing interlocking type Rubber Moulded cement concrete paver block***

***6.10: Providing and fixing interlocking type Rubber Moulded cement concrete paver block of approved shape, design and colour having 60 mm thickness (M-35), purchased from SMC's approved paverblock manufacture only and fixing on fine sand bedding. Item includes levelling by using vibratory plates compacted machine. Item also includes all material colour, equipments, tools, plants, watering, cleaning etc. complete.***

(A) Regular Paver Block (With Colour)

(B) C & D Waste Paver Block (With Colour)

Paver blocks shall be procured from SMC's approved manufacturer.

## **TECHNICAL SPECIFICATION FOR PAVER BLOCKS**

The pattern and colour of paver block shall be as per the prior approval and direction of engineer in charge.

Paver block to be used shall be as per technical specification as specified in IS 15658-2006.

## **RAW MATERIALS**

### **Cement**

The cement used in the manufacture of high quality precast concrete paving block shall be conforming to IS 12269 (53 grade) ordinary Portland Cement or IS 8112 (43 grade ordinary Portland cement). The minimum cement content in concrete used for making paver blocks should be 310 kg/Cu.M. And the upper limit of cement shall not be more than 425kg/Cu.M. Entire quantity of cement required to manufacture paving blocks shall be procured by contractor at his own cost.

### **Aggregates**

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials which, apart from the grading requirements comply with IS 383-1970. The fine aggregates used shall contain a minimum of 25% natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay and shall be free from deleterious salts and contaminants.

### **Water**

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The water shall be clean and free from any deleterious matter. It shall meet the requirements stipulated in IS:456-2000.

### **Other materials**

Any other material/ingredients used in the concrete shall conform to latest IS specifications.

### **PAVER BLOCKS CHARACTERISTICS**

The concrete pavers should have perpendicular ties after release from the mould and the same should be retained until the laying.

The surface should be of anti-skid and anti-glare type.

The paver should have uniform chamfers to facilitate easy drainage of surface run off.

The pavers should have uniform interlocking space of 2 mm to 3 mm to ensure compacted sand filling after vibration on the paver surface.

The concrete mix design should be followed for each batch of materials.

Separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The pavers shall be manufactured in single layer only.

Skilled labor should be employed for laying blocks to ensure line and level for laying, desired shape of the surface and adequate compaction of the sand in the joints.

The pavers are to be skirted all round with kerbing using solid concrete blocks of size 100 mm x 200 mm x 400 mm or as directed by the Engineer. The kerbing should be embedded for 100 mm depth. The concrete used for kerbing shall be cured properly for 7 days minimum.

### **Laying of Paver Blocks**

#### **Priming**

It will be responsibilities of the Contractors to ensure that the manhole/pipeline cable trenches/circular drainage system etc. raised to driveway level using the requisite materials as per instruction of Engg. The areas of potholes/deep depressions at the isolated locations also have to be filled up before laying the paver blocks. No extra pavements will be made for this purpose.

It will be the responsibility of the Contractors to ensure that undulations on the paver blocks are eliminated after the traffic is allowed on it. Proper slope for drainage of water needs to be ensured by the Contractor. All necessary materials, tools, tackles are required to be arranged by the Contractor.

#### **Bedding sand course**

The bedding sand shall consist of a clean well graded sand passing through 4.75 mm sieve and suitable for concrete. The bedding should be from either a single source or blended to achieve the following grading.

<b>In sieve size</b>	<b>% passed</b>
9.52 mm	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm	60-100
600 microns	25-60
300 microns	10-30
150 microns	5 – 15
75 microns	0 – 10

Contractor shall be responsible to ensure that single-sized, gap graded sands or sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp not rounded as sharp sand possess higher strength and resist the migration of sand from under the block to less frequently areas even though sharp sands are relatively more difficult to compact than rounded sands, the use of sharp sands is preferred for the more heavily trafficked driveways. The sand use for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence.

The sand shall be of uniform moisture content and within 4% - 8% when spread and shall be protected against rain when stock piled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be of 45 mm and within +/- 5 mm. Thickness variation shall not be used to correct irregularities in the base course surface.

The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following screeding. Any precompacted sand or screeded sand left overnight shall be loosened before further laying of paving blocks take place.

Sand shall be slightly screeded in a loose condition to the predetermined depth only slightly ahead of the laying of paving unit.

Any depressions in the screeded sand exceeding 5 mm shall be loosened, raked and rescreeded before laying of paving blocks.

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**Laying of interlocking Paver Blocks**

Paver blocks shall be laid in herringbone laying pattern throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not be permitted in other than approved locations.

Paver blocks shall be placed on the un compacted screened sand bed to the nominated laying pattern, care being taken to maintain the specified bond throughout the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving blocks are permitted or edge blocks may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting machine.

Paver blocks shall be placed to achieve gaps nominally 2 to 3 mm wide between adjacent paving joints. No joint shall be less than 1.5 mm not more than 4 mm. Frequent use of string lines shall be used to check alignment. In this regard the “laying face” shall be checked at least every two meters as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with.

In each row, all full blocked shall be laid first. Closure blocks shall be cut and fitted subsequently. Such closer blocks shall consist of not less than 25% of a full blocks.

To infill spaces between 25 mm and 50 mm wide concrete having screened sand, coarse aggregate mix shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill space. For smaller spaces dry packed mortar shall be used.

Except where it is necessary to correct any minor variations occurring in the laying bond, the paver blocks shall not be hammered into position. Where adjustment of paver blocks necessary care shall be taken to avoid premature compaction of the sand bedding.

**Initial Compaction**

After laying the paver blocks, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than Two (2) passes of a suitable plate compactor.

The compactor shall be a high-frequency, low amplitude mechanical flat plate vibrator having plate area sufficient to cover a minimum of twelve paving blocks. Prior to compaction all debris shall be removed from the surface.

Compaction shall proceed as closely as possible following laying and prior to any traffic. Compaction shall not, however, be attempted within one metre of the laying face. Compaction shall continue until lapping has been eliminated between adjoining blocks. Joints shall then be filled and re compacted as described in Cl. 3.5.

All work further than one metre from the laying face shall be left fully compacted at the completion of each day's laying.

Any blocks that are structurally damaged prior to or during compaction shall be immediately removed and replaced.

Sufficient plate compactors shall be maintained at the paving site for both bedding compaction and joint filling.

### **Joint filling and final compaction**

As soon as possible after compaction and in any case prior to the termination of work on that day and prior to the acceptance of vehicular traffic, sand for joint filling shall be spread over the pavement.

Joint sand shall pass a 2.36 mm (No.8) sieve and shall be free of soluble salts or contaminants likely to cause efflorescence. The same shall comply with the following grading limits.

<b>In sieve size</b>	<b>% passed</b>
2.36 mm	100
1.18 mm	90-100
600 microns	60-90
300 microns	30-60
150 microns	15-30
75 microns	10-20

The Contractor shall supply a sample of the jointing sand to be used in the contract prior to delivering any such materials to site for incorporation into the works. Certificates of test results issued by a recognized testing laboratory confirming that the samples conform to the requirements of this specifications shall accompany the sample.

The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) Pass by the plate vibrator and joints refilled with sand to full depth. This procedure shall be repeated until all joints are completely filled with sand. No traffic shall be permitted to use the pavement until all joints have been completely filled with sand and compacted.

Both the sand and paver block shall be dry when sand is spread and broomed into the joints to prevent premature setting of sand.

The difference in level (lipping) between adjacent blocks shall not exceed 3 mm with not more than 1% in any 3 m x 3 mm area exceeding 2 mm. Pavement which is deformed beyond above limits after final compaction shall be taken out and reconstructed to the satisfaction of the Engineer.

### **Edge Restraint**

Edge restrains need to be sufficiently robust to withstand override by the anticipated traffic, to withstand thermal expansion and to prevent loss of the laying course material from beneath the surface course. The edge restraint should present a vertical face down to the level of the underside of the laying course.

The surface course should not be vibrated until the edge restraint, together with any bedding or concrete haunching, has gained sufficient strength. It is essential that edge restraints are adequately secured.

### **Sampling and Testing Procedures for Paver Blocks**

#### **Sample Size**

Internal – Average of minimum 3 samples per 5000 blocks – for paver block manufacturers.

External – Minimum 2 blocks per 10000 blocks. Average of minimum 8 blocks per site – for captioned contractors.

#### **Sampling for Testing**

Sampling for testing of paver blocks shall be done in accordance with Appendix-A.

#### **Compressive Strength :-**

Testing for compressive strength shall be undertaken in accordance with Appendix-B. The average compressive strength of the 80 mm thick paver block tested shall be 50 N/Sq mm and average compressive strength of the 60 mm thick paver blocks tested shall be 45 N/Sq mm.

#### **Water Absorption :-**

Testing for water absorption shall be in accordance with IS 2185:1979:Part I (Specifications for concrete masonry blocks) Appendix C

**Abrasion Test :-** Testing for abrasion shall be carried out in accordance with IS 15658-2006

### **Appendix –A**

#### **Sampling of Paver Blocks**

##### **Method of Sampling**

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Before laying paver blocks, each designated section comprising not more than 50000 blocks, shall be divided into ten approximately equal groups. Three blocks shall be drawn from each group.

### **Marking and Identification**

All samples shall be clearly marked at the time of sampling in such a way that the designated section of Part thereof and the consignment represented by the sample, are clearly defined.

The sample shall be dispatched to the approved test laboratory taking precaution to avoid damage to the paving in transit. Protect the paving from damage and contamination until they have been tested. The samples shall be stored in water at  $20^{\circ}\text{C} + 5^{\circ}\text{C}$  for 24 hours prior to testing.

### **Appendix – B**

#### **Procedure for Testing of Compressive Strength for Paver Blocks**

Reference: BS 6717 Part I (1993) Specification for Paver Blocks

**B-1 Testing Machine:** The testing machines shall be of suitable capacity for the test and capable of applying the load at the rate specified. It shall comply, as regards repeatability and accuracy with the requirements of relevant IS specification.

**B-2 Procedure:** – The sample specimens shall be tested in wet condition after being stored at least 24 hours, in water maintained at a temperature of  $20^{\circ}\text{C} + 5^{\circ}\text{C}$  before the specimens are submerged in water, the necessary area shall be determined.

The plates of the testing machine shall be wiped clean and any loose grit or other material removed from the contact faces of the specimen. Plywood nominally 4 mm thick, shall be used as packing between the upper and lower faces of the specimen and the machine plates, and these boards shall be larger than the specimen by a margin of at least 5 mm at all points. Fresh packing shall be used for each specimen tested. The specimen shall be placed in the machine with the wearing surface in a horizontal plane and in such a way that the axes of the specimen are aligned with those of the machines plates. The load shall be applied without shock and increased continuously at the rate of approximately 15 N/sqmm per minute until no greater load can be sustained. The maximum load applied to the specimen shall be recorded.

**B-3 Calculation of Corrected Strength:** The compressive strength of each block specimen shall be calculated by dividing the maximum load by full cross section area and multiplying by an appropriate factors.

Thickness and Chamfer Correction Factors

For Compressive Strength

Work Size Thickness in mm	Correction Factors	
	Plain Block	Chamfered Block
60	1.00	1.06
80	1.12	1.18
100	1.18	1.24

**B-4 Compressive Strength Calculation:** The average corrected compressive strength for the designed block section shall be calculated.

### APPENDIX –C

#### Method for the Determination of Water Absorption

The test specimens shall be completely immersed in water at room temperature for 24 hours.

The specimens shall then be weighed, while suspended by a metal wire and completely submerged in water

They shall be removed from the water and allowed to drain for one minute

Visible surfaces water being removed with a damp cloth and immediately weighed  
Subsequent to saturation, all specimens shall be dried in a ventilated oven at 100 to 115oC for not less than 24 hours and until two successive weightings at intervals of 2 hours show an increment of loss not greater, than 0.2 percent of the last previously determined mass of the specimen.

Calculate the absorption as follows:

$$\text{Absorption, kg/m}^3 = \frac{A-B}{B-C} \times 10000$$

$$\text{Absorption percent} = \frac{A-B}{B} \times 100$$

Where A = wet mass of unit in kg

B = dry mass of unit in kg. And C = suspended immersed mass of unit in kg.

### APPENDIX –D

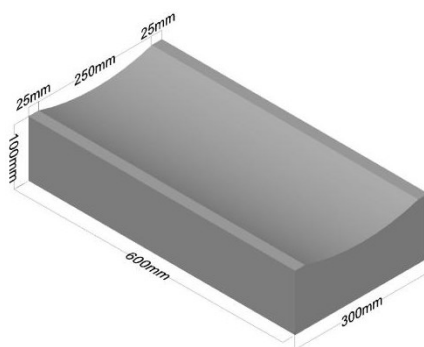
#### Durability of paver blocks

It is observed that the paver blocks get eroded due to wear & tear of traffic, in spite of passing in abrasion testing. It is therefore the mandatory requirement that the paver blocks should be durable and not adversely affected due to abrasion at least during the defect liability period of 5 years. In case of such defect observed due to abrasion or any other reason, such paver blocks are required to be replaced free of cost by the contractors.

Measurement for this item shall be in Sqm and rates for the complete item as per the item description and specification shall be as indicated in the BOQ. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

### ***Item No:6. 11 Providing and fixing in position readymade cement concrete Water Drain Channel***

***6.11 Providing and fixing in position readymade cement concrete Water Drain Channel ( 600 x 300 x 100 mm ) M-30 Grade with all labour, material, testing charge etc. complete as per details in tender specification & as directed by engineer in charge.***



Sr.	Parameters	Minimum Requirements
1.	Percentage Water Absorption	Average not over 6%
2.	Tolerance in size (length + breadth)	± 1.5mm
3.	Tolerance in Thickness of block	± 4mm

- The face of the kerb shall not exhibit defects such as cracking or flaking when examined.
- For faces described as flat and edges described as straight, the permissible deviations on flatness and straightness are given in Table 1

Table 1- Permissible deviations of flatness and straightness

Length of gauge (mm)	Permissible deviation of flatness and straightness (mm)
300	±1.5
400	±2.0
500	±2.5
800	±4.0

- Bending Characteristic of Kerb as per Table 2

Table 2- Bending Characteristic

Characteristic bending strength (MPa)	Minimum bending strength (MPa)
4.5	4.0

- The manufacturing company must be an ISO 9001 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The Kerbstone material must be tested at the manufacturer's laboratory before dispatch for: Bending strength, Water absorption, and dimensional accuracy. Internal test report needed with every supply.

Testing to be carried out in accordance with EN 1340.

### ***Item No:6.12 (A) Supplying and fixing Tree guard ID***

***7.12 (A) Supplying and fixing RCC collar (300 mm dia) for tree plantation including all taxes, carting, loading, unloading etc. complete with all labour, material charge etc. complete as per details in tender specification & as directed by engineer in charge.***

***(A) Tree guard ID 500mm, 800 x 800 x 75 mm (Type D) ( set 4)***



**Figure Tree Guard**

### ***Item No: 6.13 Removing existing kotah stone***

***6.13 Removing existing kotah stone flooring in mortar and vertical stone kerbing including stacking of serviceable material carting at SMC store disposal of unserviceable material with all lead and lift.***

Removing existing kotah stone and carting at SMC store disposal.

### ***Item No: 6.14 Providing and applying two coats of synthetic enamel paint***

***6.14 Providing and applying two coats of synthetic enamel paint including primer to kerb as per technical specifications and as directed by Engineer-in-charge.***

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## 1 Materials

The synthetic enamel paint shall conform I.S. 1932-1964. The ready mixed primer, brushing red lead shall conform to I.S. 102-1962. The thinner (linseed oil) shall conform to I.S. 75-1973. If for any reason, thinning is necessary in case of ready-mix paint, the brand of thinner recommended by manufacturer shall be used.

## 2 Workmanship

### General

The materials required for work of painting shall be obtained directly from approved manufacturer or approved dealer like Asian, Nero-lac, ICI, Berger etc. and brought to the site in marker's drums, kegs, etc. with unbroken seal.

All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become state or flute due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left-over paint shall be put back into stock tins. When not in use, the containers shall be kept properly closed.

If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.

The surface to be painted shall be thoroughly cleaned and dusted. All rust dirt, and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed parts of the work shall be carried out in wet, damp or otherwise unfavourable weather and all the surfaces shall be thoroughly dry before painting work is started.

### 3 Application of primer:

After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

During painting, every time, after the priming coat has been worked out of the brush bristles or after the burst has been unloaded the bristles of the brush shall be opened up by striking the brushing shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again in to a paint container. The primary coat shall be allowed to dry completely before painting is started.

No hair marks from the brush or clogging at paint puddles in the corner of panels angles of mouldings etc. shall be left on the work.

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Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The container when not in use shall be kept close and free air so that paint does not thicken and also shall be kept guarded from dust.

#### **4 Application of paint:**

Brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. They shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Each coat shall be allowed to dry completely and lightly rubbed with every fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall very slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

Each coat except the last coat shall be lightly rubbed down with sand-paper or fine pumice stone and cleaned of dust before the next is applied. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

Special care shall be taken while painting over bolts, butts, rivets, overlaps etc.

Approved best quality brushes shall be used.

#### **5 Mode of measurements and payment:**

The wall surface shall be measured under this item.

All the work shall be measured net in the decimal system as executed subject to the following limits unless otherwise stated hereinafter.

- (a) Dimensions shall be measured to the nearest 0.01 meter.
- (b) Areas shall be worked out to the nearest 0.01 Sq. meter.

No deductions shall be made for openings not exceeding 0.5 Sq.mt. each and no addition shall be made for painting to beadings, mouldings, edges, jambs, soffits, sills etc. of such opening.

In case of fabricated structural steel and iron work, priming coat of paint shall be included with fabrication. In case of trusses if measured in Sq.mt. Compound girders, stanchions, lattices, girder and similar work, actual area shall be measured in Sq.mt. And no extra shall be paid for painting on bolts, heads, nuts, washers etc. No addition shall be made to the weight calculated for the purpose of measurements of steel and iron works for paint applied on shop or at site.

The different surfaces shall be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with the table given as per Annexure. If for payment.

The rate shall be for a unit of one Sq. Metre.

#### ***Item no.6.15 Providing & laying cement concrete 1:2:4***

***6.15 Providing & laying cement concrete 1:2:4 (1 cement:2 sand:4 graded stone agg. 20 mm nominal size) & curing comp. Includ.cost of form work but exclu. Cost of reinforcement for reinforced concrete work in : (A) Foundation, footing, Base of columns and Mass concrete.***

**GENERAL:**All concrete works will be carried out as per relevant MORT&H Specification.

**MODE OF MEASUREMENTS AND PAYMENT:**The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed. The rate shall be for a unit of one cubic meter.

#### ***Item no.6.16 Providing and laying cement concrete Precast kerb***

***6.16 Providing and laying cement concrete Precast kerb/ cast- in-situ kerb in M-20 grade concrete as per drawing purchased from SMC's approved Manufacturer' if precast kerb laying and as directed by Engineer with all leads, lifts etc. complete. ( ii ) 0.15 (th.) \*0.30(l)\* 0.48(Ht.) mt. in size M-20 grade pre cast Kerbs for Fixing at edge of PQC as per drawing and as directed by Engineer with all leads, lifts etc. complete.***

Refer Item No.6.07

#### ***Item no.6.17 Pavement marking with hot applied thermoplastic paints***

***6.17 Pavement marking with hot applied thermoplastic paints of 2.5mm thickness including reflectorising glassbeads @ 250gms per sqm area, thickness of 2.5mm is exclusive of surface applied glass beads as per IRC:35. The finished surface to be level, uniform and free from streaks & hoels***

***For Edge line marking of 15cm width***

***For Center Line marking of 10cm width***

<b>SECTION 803</b>	<b>ROAD MARKINGS</b>
<b>Sub clause 803.2</b>	<p><b>Materials</b></p> <p>Substitute this section as under:</p> <p>“Road markings shall be of hot applied thermoplastic compound and the material shall meet the requirements as specified below.”</p> <p>General: -</p> <p>(I) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.</p> <p>(ii) The thermoplastic compound shall be screeded, lextuded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.</p> <p>(iii) The colour of the compound shall be white or yellow OS colour</p>

	<p>No. 356 as specified in the drawings or as directed by the Engineer.</p> <p>(iv) Where the compound is to be applied to cement concrete pavement, a scaling primer is recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound.</p> <p>(v) Add to this Clause Brand for Paints should be as below <b>Asian, Berger or Equivalent.</b> <b>Thermoplastic Material:</b> General: - The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads. <b>Requirements: -</b> Composition: The pigment, beads and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table below: Table: Proportions of Constituents of Marking Material (Percentage By Weight)</p> <table border="1"> <thead> <tr> <th>Component</th> <th>White</th> <th>Yellow</th> </tr> </thead> <tbody> <tr> <td>Binder</td> <td>18.0 Min.</td> <td>18.0 Min.</td> </tr> <tr> <td>Glass Beads</td> <td>30-40</td> <td>30-40</td> </tr> <tr> <td>Titanium Dioxide</td> <td>10.0 min.</td> <td>--</td> </tr> <tr> <td>Calcium Carbonate and Inert fillers</td> <td>42.0 Max.</td> <td>See</td> </tr> <tr> <td>Yellow Pigments</td> <td>--</td> <td>Note</td> </tr> </tbody> </table> <p>Note: - Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this specification are met.</p> <p>Properties: -The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part-I), shall be as below: (a)Luminance: - White: Day light luminance at 45 degree-65 per cent min. as per AASHTO M-249 Yellow: Day light luminance at 45 degrees-45 per cent min. as per AASHTO M-249. (b) Drying time: When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.</p>	Component	White	Yellow	Binder	18.0 Min.	18.0 Min.	Glass Beads	30-40	30-40	Titanium Dioxide	10.0 min.	--	Calcium Carbonate and Inert fillers	42.0 Max.	See	Yellow Pigments	--	Note
Component	White	Yellow																	
Binder	18.0 Min.	18.0 Min.																	
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Titanium Dioxide	10.0 min.	--																	
Calcium Carbonate and Inert fillers	42.0 Max.	See																	
Yellow Pigments	--	Note																	
	<p>c) Skid resistance: not less than 45 as per BS 6044.</p> <p>(d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.</p> <p>(e) Softening point: 102.5; t9.5 degree C as per ASTM D-36.</p> <p>(f) Flow resistance: Not more than 25 per cent as per AASHTO M-249.</p> <p>(ii) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M-249.</p> <p>(iii) Storage life: -The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for</p>																		

the one-year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/contractor.

(iv) Reflectorisation: - Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Reflectorizing glass beads.

(v) Marking: - Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1.The name, trade mark or other means of identification of manufacturer

2.Batch number

3.Date of manufacturer

4.Colour (white or yellow)

5.Maximum application temperature and maximum safe heating temperature.

(vi) Sampling and testing: The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The contractor shall furnish to the employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this specification.

#### **REFLECTORISING GLASS BEADS:-**

General: - This specification covers two types of glass beads to be used for the production of reflectorized pavement markings.

Type-1 beads are those which are a constituent of the basic thermoplastic compound vide above table and beads are those which are to be sprayed on the surface vide Clause table.

The glass beads shall be transparent, colorless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause table.

Specific requirements: -

(A) Gradation: - The glass beads shall meet the gradation requirements for the two types as given table below:

#### **GRADATION REQUIREMENTS FOR GLASS BEADS**

Sieve Size	Per cent retained	
	Type-1	Type-2
1.18 mm	0 to 3	--
850 Micron	5 to 20	0 to 5
600 Micron	--	5 to 20
425 Micron	65 to 95	--
300 Micron	--	30 to 75
180 Micron	0 to 10	10 to 30
below 180 Micron	--	0 to 5

(B) Roundness: - The glass beads shall have a minimum of 70 per cent true spheres.

(C) Reflective Index: -The glass beads shall have a minimum reflective index of 1.50.

(D) Free flowing properties: -The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow test.

Test Methods: The specific requirements shall be tested with the following methods:

(I) Free flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution. Cover the desiccator and let it stand for 4 hours at 20-to-29-degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.

(II) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 3262 (Part-I).

(III) The Contractor shall furnish to the employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of this specification. However, if so required, these tests may be carried out as directed by the Engineer.

**Application properties of thermoplastic material: -**

The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

The material upon heating to application temperatures, shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

**Preparation: -**

(I) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

(II) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

**Properties of finished road making: -**

(A) The stripe shall not be slippery when wet.

(B) The making shall not lift from the pave in freezing weather.

(C) After application and proper drying, the stripe shall show no

appreciable deformation or discoloration under traffic and under road temperatures upto 60-degree C.

(D) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.

(E) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.

(F) The colour of yellow marking shall conform to IS Colour No.356 as given in IS-164.

**REFLECTORISED PAINT: -**  
 Reflectorized paint, if used, shall conform to the specification by the manufacturers and approved by the Engineer. Reflectorizing glass beads for reflectorizing paints where used shall conform to the requirement of Clause table

**APPLICATION: -**  
 Marking shall be done by machine. For locations where painting cannot be done machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

The thermoplastic material shall be applied hot either by screeding on extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10 degree C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes places.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type-2, conforming to the above noted specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS-3262 (Part-3).

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks upper surface of the lines shall be level, uniform and free from streaks.

**Marking: -**Marking like lane markings, centre line marking and edge

	line marking shall be done strictly as prescribed in IRC-35-1977.
<b>Clause 803.3</b>	<b>Ordinary Road Marking paint</b> This clause is to be deleted.
<b>Clause 803.6</b>	<b>Application</b>
<b>Clause 803.6.1</b>	Substitute the first sentence of the first paragraph as under: “Marking shall be done by machine approved by the Engineer”.
<b>Clause 803.6.4</b>	The last sentence of third paragraph shall be read as under: “The glass beads shall be applied at the rate of not less than 400-gm/Sqm area.”
<b>Clause 803.6.6</b>	Add the following in the end of the clause “Line and curves, whether broken or unbroken, shall not consist of chords but shall follow the correct radius. ii) Faulty Workmanship or Materials If any materials not complying with the requirements is delivered at the Site or used in the Works, or if any sub-standard work is carried out, such material or work shall be removed, replaced or repaired as required by the Engineer, at the Contractor’s own cost. Rejected traffic markings and paint that has been splashed or has dripped onto the surfacing, kerbs, structures or other such surfaces shall be removed by the Contractor at his own cost, in such a way that the markings of split paint will not show up again later.”
<b>Clause 803.6.8</b>	<b>Measurements for Payment</b>
<b>Clause 803.6.8.2</b>	In respect of markings like directional arrows and lettering etc. the measurement shall be in Sq.m of actual area. (Excluding gaps if any)
<b>Clause 803.6.9</b>	<b>Rate</b> In second line after ‘material’ add ‘including sealing primer coat’.

### ***Item no.6.18 Supplying of Molded Shank Raised Pavement Markers***

***6.18 Supplying of Molded Shank Raised Pavement Markers made of polycarbonate and ABS molded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 16000 kg tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 – DO III Dt 11.06. 1997. The height, width and length shall not exceed 50 mm, 100 mm and 100 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 +/- 5 degree. The strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 +/- 2 mm and height not less than 30 +/- 2 mm) from the body is to be a minimum value of 500 Kgf. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin based adhesive as per manufacturer’s recommendation and complete as directed by the engineer. (3M or Equivalent Brand)***

#### **General**

Reflective pavement marker (RPM) or road stud is a device which is bonded to or anchored within the road surface for lane marking and delineation for night-time visibility. It reflects incident light in directions close to the direction from which it came.

#### **Definitions**

Description of Terms Specific to this standard

Coefficient of luminous intensity (CIL) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance at the retro-

reflector on a plane perpendicular to the direction of the incident light expressed in terms of milli candel as per incident lux (mcd/lx).

Horizontal entrance angle –the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

Observation angle – the angle in the reflector between the illumination axis and the observation axis.

Retro–reflection–reflection in which the radiation is returned in direction close to the direction from which it came. This property being maintained over wide variations of the direction of incident radiation.

Head–that part of a road stud which is above the road surface when the road studies fixed in position in the road.

Uppersurface–that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.

Anchorage–that part of a road stud which is below the road surface when the road stud is fixed in position in the road.

### **Metal**

Molded Twin Shank Raised Pavement Markers made of polycarbonate and ABS molded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 16000 kg tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 – DO III Dt 11.06. 1997.

Reflective panels shall consist if number or lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.

### **Design**

The slope or retro-reflecting surfaces shall preferably be 35+5 degree to base.

The area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

### **Optical Performance**

Unidirectional and bi-directional studs

Each reflector or combination of reflectors on each face of the stud shall have a C.I.L. not less than given in Table 1 or 2 as appropriate.

**Table 1 Minimum C.I.L Values for Category 'A' studs**

Entrance angle	Observation angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L & R	0.3°	220	110	44
0° U 10° L & R	0.5°	120	60	24

**Table 2 Minimum C.I.L Values for Category 'B' studs**

Entrance angle	Observation angle	C.I.L.in mcd/Ix		
		White	Amber	Red
0° U 6° L&R	0.3°	20	10	4
0° U 10° L&R	0.5°	15	7.5	3

Note: The entrance angle of 0 U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

A stud that incorporates one or more Corner cube reflectors shall be considered to be included in category 'A'. A stud that incorporates one or more bi-convex reflectors shall be considered to be included in category 'B'.

Omni-directional studs Each omni-directional stud shall have a minimum C.I.L. of not less than 2mcd/Ix.

### Tests

Coefficient of luminance intensity can be measured by produced described in ASTM E809 "Practice for Measuring Photometric Characteristics" or as recommended in BS:873-Part 4:1973.

Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that.

- (I) The value is not less than 80% of the specified minimum, and
- (II) The average of the left and right measurements for the specific angle is greater than the specified minimum.

**Flexural Strength:** When tested in accordance with ASTM D4280, a marker shall withstand 8914 N (909 kgf, 2000 lbf) without breakage.

**Lens Impact Strength:** When impacted in accordance with ASTM D4280, the face of the lens shall show no more than two radial cracks longer than 6.4 mm (0.25 in.). There shall be no radial cracks extending to the edge of the abrasion resistant area. There shall be no delamination.

**Shank Breakage Test:** When impacted with an Instron point and distributed load, the shanks should not break from the clamped RPM body for an applied force of less than 500 Kgf.

### Fixing of Reflective Markers

#### Requirements

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.

The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

Marker height with Molded Twin Shank shall not exceed 50mm.

Marker width shall not exceed 130mm.

The base of the markers shall be flat within 1.3mm. If the bottom of the marker is configured, the outer most faces of the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

## Placement

The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14hours.

The portions of the high way surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound,grease oil,moisture,loo .se or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

Use a wire brush, if necessary to loosen and remove dirt, then brush or blow clean.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity to result in complete coverage of the area of contact of the marker with no voids present and with as light excess after the marker has been lightly pressed in place.

For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, if necessary to remove adhesive from faces of pavement of pavement markers.

The contact or shall obtain from the manufacturer a One-year warranty for satisfactory field performanceincludingstipulatedretro-reflectanceofthereflectingpanel and submit the same to the Engineer.In addition, a One-year warranty for satisfactory infield performance of the finished roadmarkershallalsobegivenbythecontractorwhocarriedouttheworkoffixingofreflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at this own cost and with no extra remuneration to be paid for such works.

## Measurement for Payment

The measurement of reflective road markers shall be in numbers of marker supplied and fixed.

## Rate

The contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carryingout the work at site conforming to the specifications complete as per approved drawings or as directed by the Engineer.

### ***Item no.6.19 Regulatory / Mandatory Sign***

***6.19 Regulatory / Mandatory Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 60 cms. Dia Circle as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35***

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*x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.*

1. Four type of boards viz. Cautionary, Informatory, Mandatory and Directional Boards shall be as per IRC: 67-2012 as shown in the drawings.
2. The square plate and rectangle plate for writing the messages shall be of Aluminum of thickness **2 mm** on which the Retro Reflective Sheeting of Engineer Grade shall be pasted as per the standard size of the letters, signs, arrows etc.
3. The Directional Boards shall be as per the size shown in the drawings. The letters, signs and arrows shall be mentioned thereon as per the instruction of the Engineer-in-charge. The plates shall be of Aluminum having thickness **2 mm**.
4. The bidder shall invariably submit the samples of RR Sheeting (Engineer Prismatic – Blue, White, Red and Black co lours) and Aluminum sheet (Thickness 3 mm) .
5. The rates included for the RR boards including the supporting M.S. angles and fixing in prescribed concrete grade as shown in drawing.
6. The kind & nos. of boards (Mandatory-informatory-cautionary-Directional) : The numbers of each category of Boards is given in the price-bid.
7. The supporting structure & the joint of the boards with the supporting structure should withstand the wind velocity.
8. Moreover, the bidder shall submit a copy of his import license of RR sheeting or the certificate showing him the authorized dealer for Indian, in the case, the bidder is not a manufacture of RR sheeting. The successful bidder shall also procure purchase bill of parent company if asked to do so.
9. The Municipal Corporation reserves the right to accept the Tender in favour of different Tenderer on item wise basis either in full or part, OR reject all the offers without assigning any reason thereof.
10. (a)The bidder shall invariably submit the samples and also the technical literature giving full details for each item.
11. (b)The bidder shall invariably submit a warranty of 7 years from the original manufacturer of the sheeting and he shall also attach Test Certificate as recognized by the MOST.
12. (c)The payment shall be released only after the successful bidder produces the certificate regarding the "Quality and Guarantee" of the sheeting and the material supplied in the form prescribed by the Engineer-in-charge.
13. Successful bidder shall be responsible for safe delivery, erecting of the boards at various locations of Surat Municipal Corporation, Surat.
14. The rates shall be inclusive of all taxes, charges, freights, etc. & erection as directed by Engineer-in-charge.
15. No interest will accrue to be payable on the Security Deposit and Earnest Money Deposit.
16. Warranty / Guarantee period shall be minimum 12 (twelve) months from the date of completion of work. Security Deposit will be retained up to the warranty / guarantee period.

17. The material shall be inspected / tested by Corporation's representative at manufacture's work shop prior to dispatch. The successful bidder shall have to make arrangement for the same at his own cost. He shall also be required to show the live demonstration of the Retro reflective sheeting used for the sign boards at his own cost and risk in appropriate condition i.e., Dark.
18. If any of the item are not found conforming to the approved samples, the same will be rejected and will have to be replaced by the successful bidder at his own cost, risk and consequences.
19. Also, the bidder shall invariably submit guarantee / warranty for the components for the warranty / guarantee period. If any defect is found, the same will have to be replaced by the successful bidder at his own cost, however if the quality is found sub-standard, as compared to the approved sample, at any point of any times, S.M.C. shall be at its discretion to terminate the contract and security deposit shall be forfeited.
20. The details of symbols supplying computerized sticker sign (Logo) and pasting the same as per for instructions of Engineer-in-charge. The fixing at site in C.C. 1:2:4 block of size mention in the BOQ and as per drawing for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge. (A) High Intensity Grade.

### **1. General**

The colour configuration, size and location of all traffic signs shall be in accordance with the Code of Practice for Road Signs, IRC: 67-2012 as shown on the drawings. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

In general, cautionary and mandatory signs shall be fabricated through process of screen printing in regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

### **2. Materials**

The various materials and fabrication of the traffic signs shall conform to the following requirements.

#### **2.1 Concrete**

Concrete shall be of M25 grade

#### **2.2 Reinforcing steel**

Reinforcing steel shall conform to the requirements of IS:1786 unless otherwise shown in the drawing.

Bolts, nuts, washers, high strength bolts shall conform to IS:1367 whereas precision bolts, nuts etc. shall conform to IS:1364.

#### **2.3 Plates and supports**

Plates and support sections for the sign posts shall conform to IS:226 and IS:2062 or any other relevant IS Specifications. Size of base plates as per BOQ and drawings

## 2.4 Aluminum

Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS:736 - Materials designation 24345 or 1900.

## 2.5 Aluminum Composite Materials (ACM)

ACM sheets used for sign boards is a sandwiched construction with a thermoplastic core of 'Low Density Polyethylene' (LDPE) between two thick skins/sheets of aluminum with overall thickness of 4 mm and 3 mm, and aluminum skin thickness of 0.4 - 0.5 mm and 0.25 0.3 mm respectively on both sides. The retro reflective sheeting must be applied on the top surface with aluminum surface with recommended surface preparation from sheeting manufacturer. A fluorocarbon coating may be applied over the exposed surface of aluminum to ensure corrosion resistant and weather proof and thus shall conform to relevant ASTM. The mechanical properties of 4 mm and 3 mm ACM and that of its aluminum skin shall conform to the requirement given in Table 6.1, when tested in accordance with the test methods mentioned against each of them.

## 3 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick with aluminum and 3 mm thick with aluminum composite material. All other signs shall be at least 2 mm thick with aluminum and 4 mm thick with aluminum composite material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads. All overhead signs made with aluminum composite material shall be minimum 4 mm thick to withstand wind and other loads without deformation.

**Table 1: Specifications for Aluminum**

S.No.	Description	Specification for 4 mm		Specification for 3 mm
		Standard Test	Acceptable Value	Acceptable Value
<b>A</b>	<b>Mechanical Properties of ACM</b>			
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm	Min. 4 N/mm
2	Tensile strength	ASTM E638	Min. 40 N/mm <sup>2</sup>	Min. 30 N/mm <sup>2</sup>
3	0.2% Proof Stress	ASTM E638	Min. 34 N/mm <sup>2</sup>	Min. 34 N/mm <sup>2</sup>
4	Elongation	ASTM E638	Min. 6 %	Min. 5 %
5	Flexural strength	ASTM C393	Min. 130 N/mm <sup>2</sup>	Min. 120 N/mm <sup>2</sup>
6	Shear strength with punch shear test	ASTM D732	Min. 18 N/mm <sup>2</sup>	Min. 18 N/mm <sup>2</sup>
<b>B</b>	<b>Properties of Aluminium Skin</b>			
1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm <sup>2</sup>	Min. 130 N/mm <sup>2</sup>
2	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm <sup>2</sup>	Min. 70,000 N/mm <sup>2</sup>
3	Elongation	ASTM E8	A <sub>50</sub> Min. 2%	A <sub>50</sub> Min. 2%
4	0.2 % Proof Stress	ASTM E8	Min. 110 N/mm <sup>2</sup>	Min. 110 N/mm <sup>2</sup>

## 3.1 Composite Material (ACM)

In respect of sign sizes not covered by IRC:67-2012, the structural details (thickness etc.) shall be as per the approved drawings.

## 4 Having retro-reflective sheeting

### 4.1 General requirements

The retro reflective sheeting used on the signs shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International/Government Laboratory/Institute by the manufacturer of the sheeting and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacture in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in Indiameter can be accepted provisionally. In such a situation, the Employer/Client, if so desires, could seek for a performance guarantee which would be released after receipt of certificate meeting the requirement of three years outdoor weathering of the sheeting. Retro reflective sheeting is divided into three classes as follows:

- CLASS "A" SHEETING: - Engineering and Super Engineering Grade Sheeting as per ASTM.D 4956-09 Type I and II.
- CLASS "B" SHEETING: - High Intensity and High Intensity Prismatic grade sheeting as per ASTM D 4956-09 Type III and IV.
- CLASS "C" SHEETING: - All Micro Prismatic grade sheets as per ASTM D 4956-09 Type VIII,IX and XI.

### 4.2 Selection of sheeting

Performance characteristics of sheeting Type I to Type IX used for road signs are presented respectively in Table.3 to Table .9. The definition of key words in understanding the performance characteristics are given below.

"Retro-reflection" means the reflection of light which is returned in directions close to the direction from which it came, and this property being maintained even over wide variations of the direction of the incident radiameteration.

"Observation angle (symbol  $\alpha$ )" is the angle between the illumination axis and the observation axis as shown in Fig. 7.1.

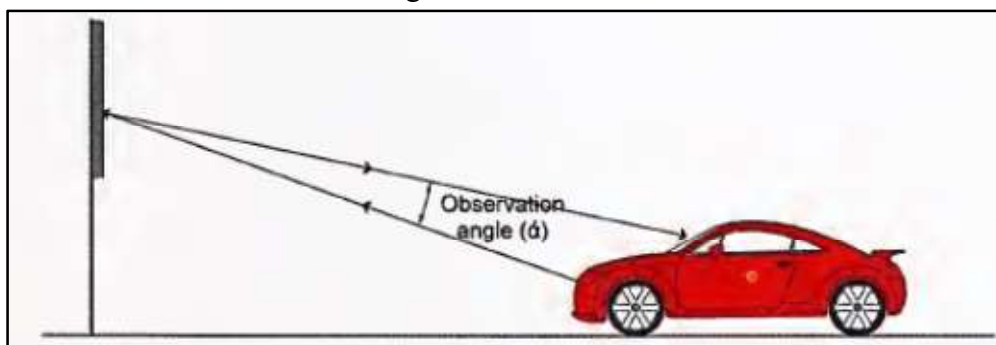


Fig. 7.1

"Entrance angle (symbol  $\rho$ )" means the angle from the illumination axis to the reference axis. The reference axis is an axis perpendicular to the retro reflective surface as shown in Fig. 7.2.

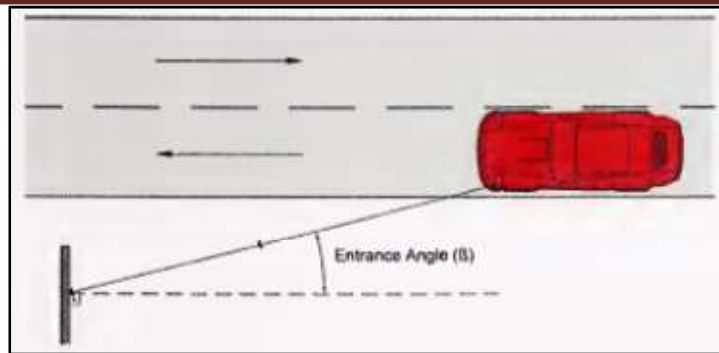


Fig. 7.2

"Coefficient of retro-reflection  $R'$ " can be obtained from the luminous intensity ( $I$ ) of the retro-reflective area in the direction of observation and the illumination ( $E - L$ ) on the retro reflective plane at right angles to the direction of the incident light and the illuminated plane sample surface  $A$ ,

$$R' = I / E - 1 * A$$

The coefficient of retro-reflection  $R'$  is expressed in candle per square meter per lux. Though the sheeting as per ASTM classification are available from Type I to Type IX, a "higher" type of sheeting used in the ASTM need not necessarily imply that it is better than a "lower"-type sheeting, rather it meets different performance characteristics. Each type of sheeting has certain performance characteristics and the type of sheeting for a road should be selected which suits the situation encountered by road users in viewing the signs on the particular road. For example, sheeting with high coefficient of retro reflection at small observation angle will give better performance for driver's viewing the sign from long distances. Similarly, signs with wide observation angle give good performance for drivers encountering situations to observe the signs involving wide observation angle. Micro prismatic sheeting is preferred for gantry mounted overhead signs. Type IV micro prismatic sheeting may be used for delimitator posts.

Table 2 suggests a general guideline for selection of sheeting considering the performance characteristics of each type of sheeting for different category of roads and also on economic consideration and visibility requirements in Indian context. However, the choice for selection of type of sheeting would rest with the client.

**Table 2 Suggested Guidelines for Usage of Retro-Reflective Sheeting**

Class of Sheeting	Type of Sheeting (ASTM)	Category of Road				
		National/ State Highway	Major District Roads	Rural Roads	Urban/ City Roads	Expressway
Class A	Type I	No	Yes	Yes	No	No
	Type II	No	Yes	Yes	No	No
Class B	Type III*	Yes	Yes	Yes	Yes	No
	Type IV	Yes	Yes	Yes	Yes	No
Class C	Type VIII	Yes	No	No	Yes	Yes
	Type IX	Yes	No	No	Yes	Yes
	Type XI	Yes	No	No	Yes	Yes

\* Type III sheeting is available both as glass beaded and micro prismatic technology as per ASTM D4956-09. The light reflecting efficiency of glass beaded sheeting is lower than the micro prismatic sheeting.

#### Class A (Engineering grade sheeting)

- **Type I engineering grade sheeting**

This sheeting shall be of enclosed lens glass bead type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table 3.

**Table 3 Acceptable Minimum Co-efficient of Retro-Reflection for Type I Engineering Grade Sheeting (Candels as per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	- 4°	70	50	25	9.0	14	4.0	1.0
0.2°	+30°	30	22	7.0	3.5	6.0	1.7	0.3
0.5°	- 4°	30	25	13	4.5	7.5	2.0	0.3
0.5°	+30°	15	13	4.0	2.2	3.0	0.8	0.2

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

- **Type II super engineering grade sheeting**

This sheeting shall be of enclosed lens glass-bead type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table 4.

**Table 4 Acceptable Minimum Coefficient of Retro-Reflection for Type II Super Engineering Grade Sheeting (Candelas per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.2°	-4°	140	100	60	30	30	10	5
0.2°	+30°	60	36	22	10	12	4	2
0.5°	-4°	50	33	20	9	10	3	2
0.5°	+30°	28	20	12	6	6	2	1

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

### **Class B (High intensity grade sheeting)**

- **Type III high intensity grade**

This high intensity retro-reflective sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface or as a non-metallic micro prismatic reflective material element. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table5.

**Table 5 Acceptable Minimum Coefficient of Retro-reflection for Type III High Intensity Grade Sheeting A (Encapsulated Lens Type)(Candelas per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 <sup>°B</sup>	-4°	300	200	120	54	54	24	14
0.1 <sup>° B</sup>	+30°	180	120	72	32	32	14	10
0.2°	-4°	250	170	100	45	45	20	12
0.2°	+30°	150	100	60	25	25	11	8.5
0.5°	-4°	95	62	30	15	15	7.5	5.0
0.5°	+30°	65	45	25	10	10	5.0	3.5

A Minimum Coefficient of Retro reflection (RA) (cd.lx 1 .nr2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

When totally wet, the sheeting shall show not less than 90 per cent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

- **Type IV High intensity micro-prismatic grade sheeting (HIP)**

This sheeting shall be of high intensity retro-reflective sheeting made of micro-prismatic retro-reflective element material coated with pressure sensitive adhesive. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table 6.

**Table .6 Acceptable Minimum Co-efficient of Retro-Reflection for Type IV High Intensity Micro-Prismatic Grade Sheeting A**

**(Candelas per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown
0.1° <sup>B</sup>	-4°	500	380	200	70	90	42	25
0.1° <sup>B</sup>	+30°	240	175	94	32	42	20	12
0.2°	-4°	360	270	145	50	65	30	18
0.2°	+30°	170	135	68	25	30	14	8.5
0.5°	-4°	150	110	60	21	27	13	7.5
0.5°	+30°	72	54	28	10	13	6	3.5

A Minimum Coefficient of Retro-reflection (RA) (cd.lx'1 .m 2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

When totally wet, the sheeting shall show not less than 90 per cent of the values of retro reflection indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

#### **Class C (Micro prismatic grade sheeting)**

- **Type VIII Micro prismatic grade sheeting**

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D: 4956-09) as indicated in Table 7.

When totally wet, the sheeting shall show not less than 90 per cent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

**Table 7 Acceptable Minimum Co-efficient of Retro-reflection for Type VIII Prismatic Grade Sheeting A (Candelas per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow -Green	Fluorescent Yellow	Fluorescent Orange
0.1° <sup>a</sup>	-4°	1000	750	375	100	150	45	30	800	600	300
0.1° <sup>b</sup>	+30°	460	345	175	46	69	21	14	370	280	135
0.2°	-4°	700	525	265	70	105	32	21	560	420	210
0.2°	+30°	325	245	120	33	49	15	10	260	200	95
0.5°	-4°	250	190	94	25	38	11	7.5	200	150	75
0.5°	+30°	115	86	43	12	17	5	3.5	92	69	35

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx~ 1. nrr2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

- **Type IX Micro prismatic grade sheeting**

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table 8.

When totally wet, the sheeting shall show not less than 90 per cent of the values, of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

- **Type XI Micro Prismatic Grade Sheeting**

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D 4956-09) as indicated in Table 9.

When totally wet, the sheeting shall show not less than 90 per cent of the values, of retroreflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 per cent of its original retro-reflectance.

**Table 8 Acceptable Minimum Co-efficient of Retro-reflection for Type IX Prismatic Grade Sheeting A (Candelas per Lux per Square Meter)**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1° <sup>B</sup>	-4°	660	500	250	66	130	30	530	400	200
0.1° <sup>B</sup>	+30°	370	280	140	37	74	17	300	220	110
0.2°	-4°	380	285	145	38	76	17	300	230	115
0.2°	+30°	215	162	82	22	43	10	170	130	65
0.5°	-4°	240	180	90	24	48	11	190	145	72
0.5°	+30°	135	100	50	14	27	6	110	81	41
1.0°	-4°	80	60	30	8	16	3.6	64	48	24
1.0°	+30°	45	34	17	4.5	9.0	2	36	27	14

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx 1 .m~2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

**Table 9 Acceptable Minimum Coefficient of Retro-reflection for Type XI Prismatic GradeSheeting.**

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Florescent yellow-Green	Florescent yellow	Florescent Orange
0.1° <sup>B</sup>	-4°	830	620	290	83	125	37	25	660	500	250
0.1° <sup>B</sup>	+30°	325	245	115	33	50	15	10	260	200	100
0.2°	-4°	580	435	200	58	87	26	17	460	350	175
0.2°	+30°	220	165	77	22	33	10	7	180	130	66
0.5°	-4°	420	315	150	42	63	19	13	340	250	125
0.5°	+30°	150	110	53	15	23	7	5	120	90	45
1.0°	-4°	120	90	42	12	18	5	4	96	72	36
1.0°	+30°	45	34	16	5	7	2	1	36	27	14

### A (Candelas per Lux per Square Meter)

A Minimum Co-efficient of Retro-reflection (RA) (cd.lx 1 .m 2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order.

### 5 Adhesives

The sheeting shall have a pressure-sensitive adhesive of the aggressive tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it

shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturer's specifications.

## **6 Fabrication**

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminum sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

## **7 Messages/Borders**

The messages (legends, letters, numerals, etc.) and borders shall either be screen-printed or cut out from durable transparent overlay or cut-out from the same type of reflective sheeting for the cautionary and mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informative and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut-out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. Whenever transparent overlay film is used for making any type of sign, the coloured portion of sign shall have coefficient of reflectivity not less than the reflectivity of type and colour of sheeting normally used, as given in Table 3 to Table 9. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay. Creating coloured areas by means of screen-printing with ink shall not be permitted.

## **8 Warranty and Durability**

The retro reflective sheeting type "A", "B" and "C" shall be covered respectively under 5-, 7- and 10-year warranty respectively issued for field performance including the screen-printed areas and cut-out sheeting and cut-out durable transparent overlay film. The contract shall indicate the minimum retro-reflectivity of the signs at the end of the warranty period.

## **9 Installation**

Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or

displacement by vandalism. Normally, signs with an area up to 0.9 Sq. mt. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be mild steel, reinforced concrete or Galvanized Iron (G. I.). Post shall be firmly fixed to the ground by means of properly designed on. The work of foundation shall conform to relevant specification as specified.

All components of signs and supports, other than the reflective portion and G. I. posts shall be thoroughly decayed, clean, primed and painted with two coats of epoxy paint. Any part of Mild Steel (M.S.) post below ground shall be painted with three coats of red lead paint.

## 10 Measurements for payment

The measurements of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured in No.

## 11 Rates

The contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

Providing, fixing and fabricating G.I. Pole/ Pipe (B-Class) having a diameter of 6.00 inch and total height 10.5 mt. (clear height - 6.5 mt. vertical and 3.00 mt. horizontal) with synthetic enamel paint (one coat red oxide and two coats of require colour) at the top. 8 ft x 4 ft - 3 mm thick Aluminum sheet supported with frame fabricated from suitable size M.S. angle 40 mm x 40 mm x 6 mm with synthetic enamel paint and provide with 3 m Retro reflective sheeting as a back ground plate dis-planning "Directions/places" in Retro reflective inclusive delivery and foundation of C.C. 1:2:4 at site complete as per attached design sketch.

Contractor have to carry out work as above-mentioned requirement and As per drawing.

### ***Item no.6.20 Cautionary Warning Sign***

***6.20 Cautionary Warning Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting***

Refer description as mentioned Item No. 8.19

**Item no.6.21 Facility Informatory Sign**

**6.21 Facility Informatory Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 80 x 60 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

Refer description as mentioned Item No. 8.19

**Item no.6.22 Direction (Junction) Sign**

**6.22 Direction (Junction) Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 244x122 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr (2 Nos.) long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

Refer description as mentioned Item No. 8.19

**Part- (B) Drainage, Protective and Miscellaneous Works****Section: 7 Drainage and Protective Works****Item No: 7.01 Providing and laying PCC M-15 grade for embeddment**

**7.01 Providing and laying PCC M-15 grade for embeddment (encassing) of water pipelines with the maximum size of coarse aggregate 20 mm including necessary form work, mixing, vibrating, curing by sprinkling / ponding of water for 14 days etc. complete.**

**Encasing of water supply pipe lines****Scope of work:**

This work shall consist of encasing and fixing of the water supply pipe lines of various diameters at the locations coming across the concrete pavement in M-15 grade concrete as per the drawings or as ordered by the Engineer and in accordance with the requirements of these specifications.

Any type of water supply pipe line / or any type of utilities crossing / running along the carriageway being concretized shall be encased in M-15 grade of concrete all around the water supply pipe periphery. The details of encasing shall be provided before the execution of the same. The contractor shall arrange metal detector equipment for locating pipe line before commencement of excavation at any location.

While doing excavation around the pipe, the contractor shall take all possible precautions to avoid any type of damage to the live pipe lines in case any damage for the water supply pipe line made by the contractor while excavation or any other activities, the pipe shall be removed and replaced at the cost of the contractor.

For carrying out excavation the technical specifications of “B” Clause 304 shall be followed. While encasing with concrete of grade M-15 shall be done as per the technical specifications of “B” Clause 1700. The necessary form work required for the concrete work in encasing the pipes shall be as per the site requirements along with the specifications of “B” Clause 1500.

After carrying out the activity of encasing the pipe lines with concrete, the trench shall be back filled as per technical specification of “B” Clause no305 & 2907

#### **MEASUREMENT FOR PAYMENT**

Concrete in sub-structure shall be measured in cubic meters in accordance with Section 1700, based on the quantity as per actual work done and approved by Engineer – in – charge. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

#### **RATE**

The contract unit rates for concrete shall include all works as given in respective sections of the technical specifications and cover compaction charges, labour charges, curing and finishing charges, all incidental items for furnishing and providing concrete for completion of work.

***Item No: 7.02 Providing and casting in situ ordinary cement concrete M 20  
7.02 Providing and casting in situ ordinary cement concrete M 20 for R.C.C. solid slab including centring scaffolding curing and finishing complete.***

Shall be in conformance with Section 1700 of Specification of Road and Bridge work (MORT & H).

Measurement for this Item will be in Cum and rates for the Item complete in all respects as per the instructions of Engineer representing SMC shall be as indicted in BOQ. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

#### ***Item No: 7.03 (a) Brick work***

***7.03(a) Brick work (Modular Type) using common burnt clay building brick having crushing strength not less than 35Kg/sq.cm in foundation and plinth in cement mortar (1:6) (1 Cement : 6 fine sand) for Utility Chambers***

Shall be in conformance with Section 1300 of Specification of Road and Bridge work (MORT&H).

Measurement for this Item will be in Cum and rates for the Item complete in all respects as per the instructions of Engineer representing SMC shall be as indicted in BOQ.

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No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

***Item No: 7.03 (b) Providing, laying & compacting 150 mm thk rubble soling  
7.03(b) Providing, laying & compacting 150 mm thk rubble soling for the foundation of the  
Utility crossing Chambers***

Shall be in conformance with Section 2505 & 2506 of Specification of Road and Bridge work (MORT&H).

Measurement for this Item will be in Cum and rates for the Item complete in all respects as per the instructions of Engineer representing SMC shall be as indicted in BOQ. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

***Item No: 7.03 (c) Providing 15 mm thk. Cement plaster 1:3 for brickwork  
7.03(c) Providing 15 mm thk. Cement plaster 1:3 for brickwork***

Shall be in conformance with Section 1300 of Specification of Road and Bridge work (MORT & H).

Measurement for this Item will be in Sqm and rates for the Item complete in all respects as per the instructions of Engineer representing SMC shall be as indicted in BOQ. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

***Item No: 7.04(A) Providing & supplying heavy duty I.S.I. mark RCC precast  
manhole frame with cover***

***6.04(A) Providing & supplying heavy duty I.S.I. mark RCC precast manhole frame with  
cover at site as per design for circular manhole complete  
(A) For Circular manhole***

Execution of this Item shall be in compliance with Item description for all activities and as per the direction of Engineer representing SMC.

Measurement shall be in No's and rates shall be indicated in BOQ. If the contractor will not deposit damaged/dismantled existing frame & cover to store/deposit of SMC, then penalty @ Rs.3000/- per each frame and cover will be recovered from his running bill.

***Item No: 7.05 Raising / lowering manholes***

***7.05 Raising / lowering manholes to the required level upto FRL of PQC including all  
materials, formwork and with 16 cm thick M20 CC coping under frames of manhole,  
including removing existing manhole frame cover and fixing existing manhole frame &  
cover or fresh heavy duty I.S.I. mark RCC precast manhole frame with cover if required,  
curing etc. complete as specified and as directed and item also includes all safety measures  
like cover the manhole with M.S. plate during execution of each layer of C.C.pavement  
and cleaning the manhole from all road debris fallen inside the manhole during  
construction activity & certified the same from engineer in charge about cleaned manhole.***

The existing manholes on the road may have to be raised or lowered according to the design Finished Road Level (FRL) of the road. The existing manhole construction is either in RCC or in brickwork with a top RCC slab in which manhole frame and cover are fixed. If the existing frame of cover are find damaged / dismantled then it should be replaced by new

heavy duty I.S.I. marked M.H. frame & cover as mentioned in item No.4.08 of B.O.Q & old frame & cover should be deposited to dept. of SMC as directed by Engineer. If the contractor will not deposit damaged/dismantled existing M.H frame & cover to store/depot of SMC then penalty @ Rs.3000/- per each frame and cover will be recovered from his running bill.

The scope of work covers the following:-

- c) Dismantling and removing RCC / brickwork to the required levels.
  - d) Providing and laying RCC M20 / brickwork in 1:6 CM including plastering in walls, and slabs of the manhole including formwork, reinforcement, heavy duty cast iron frame and cover (in case of damage / loss of existing frame during dismantling) curing, re-fixing the manhole cover etc. complete.
- item also includes all safety measures like cover the manhole with M.S. plate during execution of each layer of C.C pavement & cleaning the manhole from all road debris which fallen inside the manhole during construction activity & certified the same from engineer in charge about cleaned manhole.

**Rate:**

Rate shall be per number of the manhole raised or lowered.

If the contractor will not deposit damaged/dismantled existing frame & cover to store/deposit of SMC, then penalty @ Rs.3000/- per each frame and cover will be recovered from his running bill.

***Item No: 7.06 Dewatering***

***7.06 Dewatering: In all sorts of soil and soft murrum, hard murrum and boulders, soft rock, Hard rock, upto 1.5 mt. depth from G.L.***

***Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.***

- 7.06.1 For dewatering of drainage water from storm line and subsoil water if any shall be diverted with the help of necessary tools, bibs, plants, equipments, diesel pump, fuel etc. All the equipments required for dewatering shall be provided operated and maintained by the contractor himself. The necessary suction and delivery pipe shall be of sufficient length to divert the sewage / subsoil water from the trenches.
- 7.06.2 The contractor must repair leakage joints of storm / private drainage as early as possible as per instruction of Engineer-in-charge.
- 7.06.3 The rate includes all the tools, plants, machineries, pipes, labour, fuel etc. require for satisfactory completion of this item.
- 7.06.4 The mode of payment shall be as per the HP hour of pump so run.

Note : Payment for this item shall be made without any Premium / discount on the rate mentioned in the Price Bid.

***Item No: 7.07 Dewatering by pumping***

***7.07 Dewatering by pumping set of required capacity including temporary platform carting pumping at site and fixing the same in position including all accessories, and fuel and labour etc. complete.***

For dewatering of drainage water from storm line and subsoil water if any shall be diverted with the help of necessary tools, bibs, plants, equipments, diesel pump, fuel etc. All the equipments required for dewatering shall be provided operated and maintained by the contractor himself. The necessary suction and delivery pipe shall be of sufficient length to divert the sewage/subsoil water from the trenches.

The Contractor must repair the leakage joints of storm/private drainage as early as possible as per instruction of Engineer-in-charge.

The rate includes all the tools, plants, machineries, pipes, labour, fuel etc. require for satisfactory completion of this item.

Mode of measurement and payment: Payment shall be as per the H.P./Hour of pump so run.

### **Item No: 7.08 Providing and constructing Sewer machineholes**

**7.08 Providing and constructing Sewer machineholes, scraper machineholes and unit house connection chamber as per the type design in brick masonry in C.M.1:5 and inside and outside 20mm thick plastering in C.M.1:3 necessary 100mm coping with reinforcement in R.C.C.M200 fixing C.I.steps and fixing machinehole frame and covers (But excluding supply of machinehole frame and covers) over machineholes and house connection chambers and fixing machinehole covers (but excluding supplying of machinehole covers) over scraper machinehole etc. complete, providing and fixing safety chain wherever necessary as per the sitpulations in the type design complete as per latest CPHEEO manual. (excl. excavation).**

**(A) machinehole type "A" circular type having inside diameter of 1200mm for depth upto 1.5 m depth (for 150mm to 500mm dia sewer)**

**1. machinehole type "A" as above for 1.0 M depth**

**2. Extra depth beyond 1.0 M but upto 1.5 M depth for "A" type machinehole**

**(B) machinehole type "B" circular type having inside diameter of minimum 1500mm and for depth from 1.5 M to 4.0 M (for 150mm to 600mm dia sewers)**

**1. machinehole type "B" as above but upto 1.5 M depth**

**2. machinehole type "B" as above but upto 2.0 M depth**

**3. machinehole type "B" as above but upto 2.1 M depth**

**4. Extra depth beyond 2.1 M but upto 4.0 M depth for type "B" machinehole**

**(C) machinehole type "C" circular type having inside diameter of minimum 1500mm and for depth beyond 4.0 m to 6.0 m (for 150mm to 1800mm dia sewers)**

**1. machinehole type "C" as above but upto 4.0 M depth**

**2. Extra depth beyond 4.0 M and up to 6.0 M depth for type "C" machinehole above.**

**(D) machinehole type "D" circular type having inside diameter of minimum 1500mm and for depth beyond 6 M to 10 M (for 150mm to 500mm diameter sewers)**

**1. machinehole type "D1" as above but up to 6.0 M depth**

**2. Extra depth beyond 6.0m and up to 10 mt depth but type "D1"**

**(E) machinehole type "D2" circular type having inside diameter of minimum 1500mm and for depth beyond 6.0 M to 10.0 M (for 600mm to 1000mm dia sewers)**

**1. machinehole type "D2" as above but up to 6.0 M depth**

**2. Extra depth beyond 6.0 M and up to 10.0 M depth for type "D2" machinehole above.**

**(F) machinehole type "D3" circular type having inside diameter of minimum 1900 mm and for depth beyond 6.0 m to 10.0 m (for 1100mm to 1800mm dia. sewers).**

**1. machinehole type "D3" as above but up to 6.0 m depth**

**2. Extra depth beyond 6.0 m and up to 10.0 m depth for type "D3" machinehole above.**

**(G) Scraper machinehole type "S1" rectangular type having inside dimension 1500mm x 1500mm for 600mm dia to 1200mm dia sewer pipes and for depth 2.5 m to 9.0 m.**

**1. Scraper machinehole type "S1" as above but up to 2.5 m depth.**

**2. Extra depth beyond 2.5 m and up to 9.0 m depth for type "S1" scraper machinehole above.**

**(H) Scraper machinehole type "S2" rectangular type having inside dimension 1900mm x 1900mm for 1400mm dia. sewer pipes and for depth 2.5m to 9.0m**

**1. Scraper machinehole type "S2" as above but up to 2.5m depth.**

**2. Extra depth beyond 2.5 m and up to 9.0 m depth for type "S2" scraper machinehole above.**

**7.08.1.0 MATERIALS:**

7.08.1.1 Water shall conform to M-1, Cement Conform to M-3, Stone course aggregate of 20 mm nominal size shall conform to M-12, Grit shall conform to M-8, and Steel reinforcement shall conform to M-18-19. Fly ash brick shall conform to M-15A, Cement mortar of specified proportion shall conform to M-11, The cast iron steps shall conform to M-79

7.08.1.2 Manhole cover with frame of required size and weight shall be procured by the contractor.

#### **7.08.2.0 WORKMANSHIP:**

7.08.2.1 The manhole of different types and sizes as specified shall be constructed in sewer line at such place and to such levels and dimension as shown in drawing or as directed.

7.08.2.2 Excavation :- The excavation for construction of manhole including dismantling of all types of roads surface guarding, barricading, lightening the trenches, dewatering if required, removing and replacing, shifting of telephone/electric cables, pipe line etc. and all other safety provisions like shoring and strutting etc. till refilling of trenches and completion of manhole construction, stacking of excavated stuff within the specified lead, back filling of selected excavated earth, watering and consolidation etc. complete shall be carried out as per relevant specification of item No.1.

7.08.2.3 Concrete work :- The bed concrete in C.C. 1:3:6, Coping in C.C. 1:1.5:3 and benching concrete and in proportion c.c. 1:2:4 (1 Cement : 2 coarse sand : stone aggregate of 20 mm nominal size) by volume with necessary centering and shuttering work shall be mixed. Placed deamed and or vibrated and cured as directed by Engineer-in-charge.

#### **7.08.2.4 REINFORCEMENT:**

7.08.4.1 All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be security held in position during placing of concrete by annealed No. 1 binding work not less than 1 mm is size and by using stay block or metal chair spacers, metal hangers, supporting wires or other approved devices it sufficiently close intervals. Bars shall not be allowed to bag between supports nor displaced during concrete of any other operation of the work. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings.

Bars shall be bend cold to specified shape and dimensions or as directed, attain proper radius of bends, Bars shall not be bent or straightened in a manner that will injure the materials. Bars bend during transport of handling shall be straightened before being used on the work. Unless otherwise specified for mild steel a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement.

In case which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The cold twisted steel

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bars shall be used or without hooks at the ends. Deformed bars without hooks shall however, comply with relevant anchorage requirements.

7.08.4.3 Bars crossing each other where required shall be secured by binding wires (annealed) of size not less than 1 mm in such a manner that they do not slip over each other at the time of fixing and concreting.

7.08.4.4 As far as possible bars of full length shall be used. In case this not possible over lapping of bars shall be done as directed. The overlaps shall be staggered for different bars and located at points along the span where either shear or bending moment is maximum.

7.08.4.5 When permitted or specified on the drawings joints of reinforcement bars shall butt welded so as to transmit their full stresses. Welded joints shall preferably located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work.

#### **7.08.5.0 BRICK MASONRY WORK:**

7.08.5.1 Before masonry is to be laid on concrete footing the top of concrete shall be cleaned and moistened. The contractor shall obtain the Engineer's approval for one foundation, bed, before foundation masonry is started.

7.08.5.2 Wetting of Bricks: The brick required for masonry shall be thoroughly wetted with clean water for amount two hours before use or as directed. The cassation of bubbles, when the bricks are wetted with water is an indication of through wetting of bricks.

7.08.5.3 Brick shall be laid in English bond unless directed otherwise. Half or out bricks shall not be used except when necessary to complete to bond. Closers in such case shall be cut to required size and used bear the ends of walls.

7.08.5.4 A layer of mortar shall be spread on full width for suitable length of the lower course; each brick shall first be properly bedded and set home by gently tamping with handle of trowel or wooden mallet. It's inside face shall be flushed with mortar the next brick is laid and pressed again it. On completion of course, the vertical joints shall be fully sealed from the top with mortar.

7.08.5.5 The wall shall be taken up truly in plumb. All corners shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of brick course shall be kept uniform.

7.08.5.6 The brick shall be laid with from up wards. A set of tools comprising of wooden straight edges, monsoon spirit level, square half meter rub, and pins string and plumb shall be kept on the site of work for frequent checking during the progress of work.

- 7.08.5.7 Both the faces of walls of thickness greater than 23 cms. shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not stopper than 45 degrees.
- 7.08.5.8 All fixtures like pipe inlet and outlet of water C.I. Steps, manhole cover and frame etc. which are required to be built in wall shall be embedded in cement mortar.
- 7.08.5.9 Brick shall be so laid that all joints shall not expose 12 mm. The face joints shall be raked out as directed by raking tool daily during the progress of work, when the mortar in still green so as to provided key for plaster or pointing to be done.
- 7.08.5.10 For the face of brick work, plastering is to be done joints shall be racked out to a depth not less than thickness of joints. The face of brick work shall be cleaned and mortar dropping removed on very same day that brick work is laid.

#### **7.08.6.0 PLASTER WORK:**

- 7.08.6.1 The surface shall be cleaned of all dust, loose mortar droppings, traces of algae efflorescence and other foreign mortar by water or by brushing. Smooth surface shall be roughened by wire brushing if it is not hard and by backing if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work. The surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that done of the reerarders is left on the surface. Trimming of projections on brick/concrete surface where necessary shall be carried out to get an even surface.
- 7.08.6.2 The work shall be soaked but only damped evenly before applying the plaster. If the surface become dry, such areas shall be moistened again.
- 7.08.6.3 The plaster about 15 x 15 cms. shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surface of these gauges shall be truly in plane of the finished plastered surface. The mortar shall than be applied in uniform surface slightly more than the specified thickness, then brought to a true surface be working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel of wooden float accordingly excessive toweling of over working the float shall be avoided. All corners arrises angles and junctions shall be truly vertical of horizontal as the case may be and shall be carefully finished. Rounding or chambering corners, arises junctions etc. shall be carried out with proper templates the size required.
- 7.08.6.4 Cement mortar for plaster shall be used within half an hour after addition of water. And mortar for plaster which is partially set shall be rejected and removed forthwith from the site.
- 7.08.6.5 In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommending the plaster the edge of the old work shall be scraped clear and wetted with cement putty before plaster is applied to the adjustment areas to enable the two to properly together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. to any corners of arises. It shall not be closed on the body of features such as plaster bends and cornices not at the corners or arises. Horizontal joints in plaster work

shall not also occur on walls and copings these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up latter on.

**7.08.7.0 POINTING:**

7.08.7.1 The flush pointing work shall be carried out with mortar of required proportion by volume before pointing to be started the joints shall be raked to such depth that the average of new mortar measured from eight the sunk surface of the finished pointing or from the edge of the brick shall be average 10 mm.

7.08.7.2 The mortar shall be pressed in to the raked out joints with a pointing trowel according to the type of pointing specified in item. The mortar shall not spread over the corner finished with the fixing of C.I. Steps and M.H. cover pointed tools.

**7.08.8.0 FIXING OF POLY PROPYLENE STEPS AND MANHOLE COVER:**

7.08.8.1 During the construction of masonry wall of the manhole the cement mortar of required proportion shall be used for embedding the Poly propylene steps in the wall masonry. The spacing of steps in the masonry shall be 300 mm centre to centre in the staggered position in the vertical direction with two staggered rows at 385 mm centre to centre in the horizontal direction the top of the manhole shall not be more than 300 mm above the benching and the centre line of two staggered rows shall be the centre line of the shorter side of manhole frame in the roof of chamber.

The detailed specifications for the "Poly propylene steps as below:

The Polypropylene conforming to an ASTM D-4101, injection molded around a 12 mm dia. IS 1786 grade Fe-415 steel reinforcing bar and should meet the load required 225 Kg. as per IS-5455. The measurement should be as per attached drawing. The tolerance in the length and width is +/- 5 mm and +/- 1 mm in thickness. The weight of the steps should not be less than 0.900 Kg.

7.08.8.2 Unchequered portion of the step shall be inserted with the risk cement mortar during the course of masonry work so constructed around the steps as to keep the step on its right position. The non-slip grap chequered portion of the steps shall be well kept outside the masonry.

7.08.8.3 During fixing of the steps, the shall not be damaged and shall not vibrate or shall not shake during ascents and decants otherwise they shall have to be re fixed correctly as per the drawings or as mentioned above.

7.08.8.4 Manhole frame shall be firmly and securely laid on top of shafts of conical tops in 25 mm thick cement mortar and shall be embedded in 150 mm the cement concrete of proportion 1:2:4 (1 Cement : 2 coarse sand : 4 Kapachi as aggregate of 20 mm nominal size) in such a way that the top of M.H. frame shall be flush with concrete surface and top surface neatly finished 25 mm thick with cement mortar 1:3 in conformity with ground or road levels.

**7.08.9.0 OTHER REQUIREMENTS:**

7.08.9.1 As per line and level and size of the manhole pit shall be excavated as per drawing or as ordered by the Engineer.

7.08.9.2 The foundation concrete 1:3:6 with required thickness as per drawing or as directed shall be laid after compacting the bottom of the pit. The cement concrete shall conform to specified specification of Cement Concrete.

- 7.08.9.3 The clear inside chamber size of opening shall be as per the drawing or as directed by the Engineer-in-charge.
- 7.08.9.4 The masonry wall shall be plastered inside with 15 mm thick 1:3 cement mortar and outside with flush joint. The off set for the concrete foundation shall be 100 mm on all sides beyond walls of chamber.
- 7.08.9.5 Whenever pipes enter or leave the masonry chamber bricks on edge must be so laid around the upper half of the pipes so as to form the arch to prevent the weight of the masonry chamber over it.
- 7.08.9.6 On the top of masonry walls 1:1 cement mortar shall be laid and then R.C.C. slab of grade 1:2:4 necessary and as directed by the Engineer with coarse aggregate of trap metal of 20 mm nominal shall be laid necessary from work and centering shall have to be provided by the contractor at his own cost as per relevant specification of cement concrete.
- 7.08.9.7 In the bottom of manhole the channel and benching shall be done in C.C. 1:2:4 (1 Cement : 2 Coarse sand : 4 graded stone aggregate of 20 mm nominal size) rising at a step in line from edge of the channel, the channel of the bottom of the chamber shall be plastered 15 mm thick in cement mortar. 1:3 (1 Cement : 3 fine sand) and steel trowel smooth.
- 7.08.9.8 Channels shall be in semi circular in the bottom half and a diameter equal to the sewer. Above the horizontal diameter, the side shall be extended vertically to the same level as the crown of the out going pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junctions with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given.
- 7.08.9.9 For conical shaft of manhole necessary conical portion shall be treated from 750 mm below the bottom of concrete of slab for fixing of manhole cover and frame.
- 7.08.9.10 The item includes curing of all the cement work for 14 days.

#### **8.10.1 MODE OF MEASUREMENTS & PAYMENTS:**

- 8.10.1 Payment shall be made on the basis as per number of masonry manholes chambers constructed with all constructing materials labours, refilling curing, finishing providing and fixing C.I. steps constructing laying half round gutter fixing R.C.C. manhole cover etc. complete in all respect for incomplete item. Payment will be made on part rate basis.
- 8.10.2 The item will be paid per No. of construction of complete masonry manhole chamber as shown in the drawing up to the depth specified and shown in the type design drawing. For every increase or decrease in the minimum specified depth of masonry manhole chamber increase or decrease in rate shown in schedule B will be given taking in the construction every 10 CM increase or decrease depth of masonry chambers. For the purpose of payment of masonry chamber every increase or decrease of the 10 cm depth than the specified minimum depth of masonry manhole chambers as shown in drawing, an extra increase or decrease payment of

rupees as mentioned in Schedule-B will paid more or deducted for every 10 cm depth.

8.10.3 The measurements shall be made for such number of chambers construction. The surplus excavated stuff shall be disposed of within a radius of 10 Kms. as directed by Engineer-in-charge without any extra claim.

8.10.4 The depth of manholes shall be the distance between the top manhole cover and the invert level of the main drain. The rate includes all labours, materials, tools and plant etc. required for satisfactory completion of this item as directed above.

8.10.5 The item include :-

- (i) Bed concrete slab concrete and copping with necessary reinforcement.
- (ii) Necessary brick work with cement plaster inside and outside completely.
- (iii) Providing and fixing polypropylene steps.
- (iv) Carting, conveying and fixing of manhole frame cover with necessary concrete and finishing.
- (v) Refilling with necessary watering and consolidation.
- (vi) Curing for 14 days.

***Item No: 7.09 RCC precast M.H. frame & cover manufacture***

***7.09 RCC precast M.H. frame & cover manufacture, supply & Delivery at store or at site of work precast RCCM-200 frame & cover suitable to drainage M.H. and as per type design & Drawing including cost of reinforcement M.S. Angles or Flat, curing mold work etc.***

***(A) For circular machinehole of ISI marks (Heavy duty) 560 mm dia.***

***(B) For scrapper machinehole.***

Outer diameter	:-	860 mm
Thickness	:-	175 mm
Protection for edge	:-	25 x 25 x 3 mm M.S. angle shall be provided to project the edges of frame with anti corrosive paints.
Clear Opening	:-	560 mm
Tolerance	:-	+/- 5 mm.
Heavy duty Cover (Circular)	:-	
Outer diameter	:-	715 mm
Thickness	:-	100 mm
Lifting hooks	:-	16 mm Tot Bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes.
Protection for edge	:-	Same as for frame.
Design Load and carrying capacity:		35 M.T.
Tolerance	:	+/- 5 mm

NOTES:-

- (i) Cover shall conform I.S. 12592 (Part-I 1988.)
- (ii) Frame shall conform I.S. 12592 (Part-II 1991)
- (iii) After production of each lot of manhole frame and cover the contractor shall send the offer letter for testing of same to Drainage Engineer. The authorised representative of Drainage Engineer shall select the specimens of cover as per I.S. for the load test, which should be carried out at S.V.R.College of Engineering, Surat. The specimens of frame should be checked for its reinforcement which must be provided as per detailed drawings

attached with tender. The cost for testing of manhole cover and frame broken for inspection shall be born by the contractor in any case.

**(b) For Scraper manhole.**

**DIMENSIONS FOR EACH SLEEPER:**

Length (L) 1100 mm

Breadth (B) 350 mm

Thickness (T) 100 mm

Protection for edge: - 25 x 25 x 3 mm. M.S. angle shall be provided to protect the edges of sleeper and the four sides of sleeper shall be covered with 100 mm width M.S. strip having thickness 2 mm.

Clear Opening of

Scraper manhole :- 900 mm x 1200 mm

Reinforcement :- As show in drawing.

Frame :- Frame shall be made from 2 mm thick M.S. plate as shown in drawing.

Lifting Hooks :- 16 mm M.S. bar welded to the bottom steel.  
It shall be easily and quickly opened with crow bars and pickaxes.

Design load and Carrying capacity :- 25 M.T.

**NOTES:-**

- (i) After production of each lot of sleepers the contractor shall send the offer letter for testing of same to Engineer-in-charge. The authorised representative of Engineer-in-charge shall select the specimens of sleepers as per I.S. for the load test which shall be carried out at S.V.R. College of Engineering, Surat. The cost of testing of sleeper for inspection shall be born by the Contractor in any case.
- (ii) 4% of the sleepers will be selected for load test and if the sample fails to carry the designed load, the whole lot shall be liable for rejection.
- (iii) 25% of the prepared loat shall be selected for physical (for dimension and workmanship) testing. The tolerance given below shall be strictly followed.  
Length - 1100 mm +/-5 mm  
Width - 350 mm +/-3 mm  
Thickness - 100 mm +/-2.5 mm
- (iv) Each sleeper shall be marked with your of manufacturing and notation of SMC-DRG.

**MODE OF MEASUREMENT AND PAYMENT:**

The mode of payment shall be as per No.

***Item No: 7.10 Providing and Supplying ISI standard R.C.C.pipes***

***7.10 Providing and Supplying ISI standard R.C.C.pipes (of Sulphate Resisting Cement) instandard lengths of following class and diameter suitable for either collar jointsor rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to department stores, stacking etc. complete. (IS458/ 1989) Note: One collar should be supplied with each full length plainended RCCpipe, cost included in rates below. One rubber ring should be supplied with each full***

*length socketed pipe, cost included in rates below.*

*Lowering, laying and jointing RCC pipes in C.M.1:11/2 of following diameters in proper position, grade and alignment at all levels directed by Engineer-in-charge including conveyance from stores to site of work, labour, giving hydraulic testing as per ISI code.*

*Class NP2 Test Pressure 0.7 Kg. / sq. cm.*

*250.00 mm Dia*

*400.00 mm Dia*

*600.00 mm Dia*

#### **7.10.1.0 MATERIALS :**

7.10.1.1 R.C.C. NP2 and NP3 spun pipes of various diameters and of required length with collars shall be brought by the contractor. The contractor shall have to cart the same to the site of work as per requirements. The pipes and collars shall conform to I.S. 458 (concrete pipes with or without reinforcement) 2002 latest version.

R.C.C. spun pipes or collars shall be designed such that the maximum tensile stress in circumferential steel due to the specified hydrostatic test pressure does not exceed the limit of 1265 Kg/Sq.cm. in the case of mild steel rods, 1400 Kg/Sq.cm. in the case of cold drawn steel wires and 340 Kg/Sq.cm. in the case of soft grade mild steel wires.

The Barrel thickness shall be such that under the specified hydrostatic test pressure, the maximum tensile stress in concrete when considered as effective to take stress along with the tensile reinforcement shall not exceed 20 Kg/Sq.cm. but the minimum barrel thickness shall be not less than 25 mm.

Longitudinal steel shall be provided not only for the purpose of forming a reinforcement cage of the required shape and size but also to be adequate as assessed by calculation to support as a hollow circular beam twice the design load and twice the weight of water required to filled across span equal to the length of pipe.

Extra spiral reinforcement of mild steel wire of diameter 3.15 mm at the end of the pipe shall be closely spaced, the spacing not exceeding 2.5 cm or 1/2 of the pitch whichever is less for a length of 150 mm minimum damage during handling.

The reinforcement in the reinforced concrete pipe shall extend through the length of the pipe and shall be so designed that it may be readily placed and maintained to designed shape and in the proper position within the pipe mould during the manufacturing process. The circumferential longitudinal reinforcement shall neither more than 10 cm. or four times the thickness of barrel, whichever is less nor less than the maximum size of aggregate plus the diameter of the bars used.

#### **GENERAL**

The methods of manufacture shall be such that the form and the dimensions of the finished pipe are accurate within the limit specified in Indian Standard No.458. The surface and edges of the pipes shall be well defined and true and their ends shall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.

#### **CONCRETE MIXING :**

Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall the mixing be done for less than two minutes.

The concrete shall be placed before setting has commenced. It shall be ensured that the concrete is not dropped freely so as to cause segregation. The concrete shall be consolidated by spinning, vibrating, spinning combined with vibrations, or other appropriate mechanical means.

**REINFORCEMENT CAGES :**

Reinforcement cages for pipes shall extend throughout the pipe barrel and shall be wound round normal collapsible frames or drums. The cages shall consist of spiral or rings and straight of an annealed wire cold drawn wire or mild steel rod and may be circular cages shall be placed symmetrically with the thickness of the pipe wall.

Where double reinforcement cage is used the amount of steel in the cage shall be 75 percent of the weight of the inner cage while the total shall conform to those specified in the relevant tables of these specifications.

**CURING :**

Pipes manufactured in compliance with this standard shall be cured by immersion in water for a period of not less than two weeks in case of pipes made from ordinary portland cement or blast furnace slag cement and not less than one week in case of pipes made from rapid hardening portland cement. In the case of large pipes projecting partly above water level, the projecting portion shall be kept wet by any suitable means.

**WORKMANSHIP AND FINISH :**

Pipes shall be straight and free from excepting craze cracks. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight in the trench on opening between ends in contact shall exceed 3 mm in pipes upto 600 mm diameter (inclusive) and 6 mm in pipes larger than 600 mm diameter.

The outside and inside surface of the pipes shall be smooth, dense and hard and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacturer or supplier.

The pipes shall meet the test requirements viz. Their edge bearing test, absorption test, hydrostatic test, permeability test, straightness test etc. as per I.S. 3597-1985.

The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Pipes shall be free from load bents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

**MARKING :**

The following information be clearly marked on each pipe.

- (a) Class of pipe.
- (b) Date of manufacture and
- (c) Name of manufacturer or his registered trade mark or both.

Each pipe may also be marked with the I.S.S. certification mark.

**SUPERVISION :**

The contractor shall put the manufacturing order to the competent firm under intimation to Department and under consent supervision of Department. The pipes shall be got by manufacturer to the required specification of latest I.S.S. one pipe from every lot of 100 pipes shall be broken in the presence of concerned, Engineer-in-charge or his representative and steel can shall be got weighed. Pipes shall be tested hydraulically as per I.S. 458 & 3597 to the required pressure in presence of concerned Engineer-in-charge or his representative and if during testing pipe found not to the requirement the whole lot shall be get rejected. Load bearing of pipes also shall be tested as per I.S. 458 & 3597.

- 7.10.1.2 The jointing materials such as sand, jute, rope, bitumen etc. shall be brought by the contractor at his own cost. The sand shall be clean, sharp hard and well graded and conform to I.S.-383 (Coarse and fine aggregates from natural sources of concrete 1970 or latest version. It shall be washed before its use if, it contains clay, dirt etc. the jute, rope shall be of best quality, clean fibre free of dirt and knots. The jute 1-3 ply twisted rope of Ambadi hemp about 2 mm. thicker in diameter than annular space between collar and pipe shall be used.

**7.10.2.0 STACKING OF MATERIALS :**

- 7.10.2.1 Each and every pipe shall be examined inside and before laying, all pipes and fittings shall be found and free from visible defects. The pipe and fitting shall give a sharp clear noise when struck with light hammer.
- 7.10.2.2 Reasonable care shall be exercised in loading, transporting and unloading of the pipes and specials. Gradual unloading shall be done by inclined plane or by chain block. Handling shall be done such as to avoid impact.
- 7.10.2.3 Any damaged pipes, specials or collar shall be removed immediately from the site of work at the cost of the contractor.
- 7.10.2.4 The contractor shall have to make his own arrangements for obtaining permission for storing and stacking of pipes, specials and jointing materials, etc. by the road side from land owners i.e. concerned Government department, Municipalities or other local bodies or private owners.
- 7.10.2.5 Before, the actual laying of pipe line started, the pipes and fittings in required quantity shall be arranged lengthwise, by the site of the excavated trench without causing any obstacles to the traffic. If necessary, the pipe shall be got cut by the contractor at his own cost to accommodate specials or fittings or for any other reason.

- 7.10.2.6 The contractor shall be fully responsible for safety of materials at site.

**7.10.3.0 PREPARATION OF PIPES :**

The pipes and specials shall be brushed throughout to remove any soil deposited or stones therein, particularly each end of the pipe shall be carefully cleaned, where jointing is to be done.

**7.10.4.0 LAYING :**

- 7.10.4.1 Before laying, the trench section shall be got checked for its level and uniform grade as per L-section and plan and finished with proper bedding if required as directed, with the help of sight rails and bonning rods and shall be got approved from the Engineer-in-charge.
- 7.10.4.2 Drainage pipes are always laid with the socket at the higher and consequently, it is necessary to beginning at the lower end of drains and to work upwards laying pipes shall conform to I.S. 783-1967 or its latest version.
- 7.10.4.3 The contractor shall provide and maintain sight rails and bonning rods. The pipes shall be laid in a complete straight line with centre lines ranged accordingly by means of string stretched between sight centres of cross rails and no deviation will be permissible between the manholes. The pipe shall be laid from manhole started from the lower end. The bottom concrete of the manhole must be finished simultaneously with laying joints of pipes in that section.
- 7.10.4.4 Temporary Bench mark shall be provided by the contractor at a minimum distance of every 150 meters without any extra claim. These B.Ms. shall be either of stone masonry or mass concrete not less than 0.14 Cu.mt. The site of B.M. kept will be directed by the Engineer-in-charge.
- 7.10.4.5 The pipe shall be laid in reasonably dry condition and under no circumstances they shall be rest on slushy bedding.
- 7.10.4.6 The pipe shall be lowered by means of wooden bull and rope in case of light pipe upto 225 mm dia. while tripped and chain pulley block of sufficient capacity shall be used for heavy pipes above 250 mm dia.
- 7.10.4.7 No brick bats or hard stone or kapachi bigger than 20 mm size shall be allowed beneath the pipe line directly in touch with the pipe. Murrum bedding shall be provided if only directed by the Engineer-in-charge.
- 7.10.4.8 The pipe shall be laid in such a way that their longitudinal joints shall always come on the top and quite centre. The long collar shall first slipped over after cleaning the ends of pipes. The wedge shape groove at the end of the pipe shall be

slipped with required quantity of jute dipped in hot tar or bitumen. The bitumen for this shall be heated till it is sufficiently plastic.

7.10.4.9 The next pipe shall than be brought forward and pressed till the jute ring in recess of first pipes sets in to the recess of the second pipe. The process shall be repeated for two three pipes, which shall than the packed up in usual manner by jack and in doing so, care shall be taken to see that there shall be no deflection from the alignment.

7.10.4.10 The collar than shall be brought systematically over the ends of pipes and kept equi-distance from the pipe with help of ends necessary wedge placed along periphery of collar. The space between the inside of colar and outside of the pipe shall be sprinkled with just sufficient water to make in to damp condition.

#### **7.10.5.0 PREPARATION OF MORTAR :**

7.10.5.1 Cement mortar of cement and sand shall be prepared in workman like manner in proportion of one (1.0) part of cement with one (1.0) part of sand in volume. First dry mixing shall be carried out and then added sufficient quantity of water to have a consistances of a semi-dry condition, suitable for caulking by caulking tools.

7.10.5.2 The mortar shall be prepared on clean and water tight platform and in required quantity only and shall be taken in to use before it starts setting. Only fresh mortar shall be used.

#### **7.10.6.0 CAULKING :**

7.10.6.1 The mortar so prepared shall be rammed and well packed and pressed with a caulking tool in to the annular space, the caulking shall be so firm that it shall be difficult to drive penknife into. The joint shall be finished off with a fillet slooping 45 degree alongwith the length of pipe. It shall be finished smooth with cement slurry.

7.10.6.2 If sub-soil or surface water meet with, the caulking shall be done with near quick setting cement mixed with water proofing compound, the whole caulking job shall be carried out in dry condition till cement joint set No extra payment shall be made on account of such job.

7.10.6.3 The joints shall be protected unti final set, from sub-drying winds, rain and frost.

7.10.6.4 In no case suh-soil water shall be allowed to rise in or above the pipe line before the cement mortar of joint has set up. Every precautions shall be taken to avoid floting of pipe line due to accumulation of water in the trench while pipe line is empty. No working or walking over the pipe after they are laid shall be allowed. After pipeline is jointed, earth shall be refilled on the sides of the pipeline upto the top of the pipe keeping at least 90 cm length of pipe line open at the joints. The refilling shall be done strictly as per specification of item of refilling of trenches. Care shall be taken to see that after such refilling, joints remain completely opened around till final set and hydraulic test is given and joints are inspected for leakage under pressure.

#### **7.10.7.1 CURING OF JOINTS :**

Every joints shall be kept wet for about 10 day for maturing. The section of pipe line jointed shall be convered with wet gunny bags and kept moist continuously for above said curing period.

#### **7.10.8.0 HYDRAULIC TEST OF PIPES :**

7.10.8.1 The contractor shall give at his own cost necessary hydraulic test of pipe line laid.

7.10.8.2 Each section of drain shall be tested for water tightness preferably between manholes.

To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to back fill the pipes upto the top, keeping atleast 90 cm. length of pipe open

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at the joints. It is necessary aht the pipeline are filled up with water for about a week before commencing the application of pressure to allow for the absorption by pipe wall. Pipes shall be tested after the cement mortar joints have been made.

- 7.10.8.3 The line shall be tested as per I.S.8127-1967 (code of practice for laying for glazed stone-ware pipes) or its latest edition.
- 7.10.8.4 The contractor shall provide at his own testing equipment of approved make. This shall be approved by the Engineer-in-charge.
- 7.10.8.5 All pipes, specials, joints found to be leaking or cracked or bursted or observed unsuitable shall be removed and repaired. Contractor shall see that no end of any pipe length is kept open even temporarily and that all open ends are immediately at the end of every days work covered up either layer gunny bag cloth binded, properly by means of mild steel wires without any claim for extra cost.
- 7.10.8.6 Filling above the drains to a depth of twice the diameter of the pipeline shall be completely free from boulders, stones, or brick bats and shall be composed of selected hard variety of murrum well consolidated but not heavily tempered. In the remaining depth, the trench shall be filled up by the selected stuff and muttum as ordered by the Engineer-in-charge.
- 7.10.8.7 For crossing of obstacles, natural or built up, such as culvert drains bridges etc. the contractor shall approach respective authorities to obtain permission for crossing them. Such work left remaining to be carried out due to want of permission shall be carried out at any later stage or period within a time to the satisfaction of the Engineer-in-charge.

#### **7.10.9.0 GENERAL :**

- 7.10.9.1 After the satisfactory test of draining line the rubber plugs fitted to Y or T branches shall be taken out and ends shall have to be closed with cement concrete plugs or bricks bats as directed by the Engineer-in-charge. These plugs shall be fixed with mud mortar or cement mortar over the mud mortar of about 6 mm to 12 mm thick shall be plastered. All those works shall be done strictly as per instructions of the Engineer-in-charge. If directed, alternatively the branches of Y or T after fixing plugs shall be properly closed with a place of gunny bag and the same shall be tied with M.S. wire . The rate shall include the cost of all these materials and labour etc. complete.
- 7.10.9.2 If pipe-lines are laid in separate detached sections and not in continuous length due to any reasons, such as non-availability of pipes or due to obstacles or due to non-availability of permission etc., the contractor shall complete the work after words at the same rate as originally provided for the tenderer, without any claim for extra or compensation due to non-respect of permission or any other natural or unforeseen reasons and until the date of completion of work, shall be treated as in-complete.
- 7.10.9.3 Complete arrangements for water supply requirements for complete construction of work, hydraulic testing and for layout shall be done by the Contractor at his own cost. The water shall potable.
- 7.10.9.4 The contractor shall appoint a qualified site supervisor who can take the responsibilities and fixing the inner levels of the drains.
- 7.10.9.5 Temporary bench marks shall be provided and protected by the contractor at a minimum distance of every 150 meter at site without any extra cost. These bench marks shall be either of masonry or mass concrete or not less than 0.140 Cu.mt. The site of B.M. kept will be directed by Engineer-in-charge.

7.10.9.6 The rate includes crossing of all obstacles such as electric wire, telephone cable, water pipes, sewer, drains, manholes walls, culverts, khalkuvas, etc. coming in the laying of pipe lines work. Any damage done to this may be restored by the contractor without any extra claim. Any work of removing, repair of such structures or constructed in the process of laying pipe lines etc. shall be carried by the contractor without any claim for extra cost. Arrangements for dewatering and cleaning the khalkuvas shall be done by the contractor without any extra claim.

**7.10.10.0 MODE OF MEASUREMENT AND PAYMENT :**

7.10.10.1 The measurements shall be paid per meter length of the pipe line laid, jointed and tested and measured along the centre line and shall be paid according to the inner diameter of the pipes providing and as per the rates quoted by the tender in respective items of Schedule-B.

7.10.10.2 The pipes may be available in approximate size either in metric system, or British system. No additional payment or reduction in payment will be made for such approximate size.

7.10.10.3 No extra payment for dewatering or installing dewatering sets for pumping out such water shall be made. No extra payment for collar pits shall be made. No extra payment for cutting of pipes, if required shall be made to the Contractor.

7.10.10.4 In absence of hydraulic test 20% of the amount of the laying and jointing work of pipe line work will be withheld from the running bills till satisfactory hydraulic test is given. If level for invert of pipes is not maintained by the Contractor 100% payment shall be withheld.

***Item No: 7.11 Providing and Supplying ISI standard R.C.C. pipes***

***7.11 Providing and Supplying ISI standard R.C.C. pipes (of Sulphate Resisting Cement) in standard lengths of following class and diameter suitable for either collar joints or rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to department stores, stacking etc. complete. (IS 458 /1989) Note: One collar should be supplied with each full length plainended RCC pipe, cost included in rates below. One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.***

***Lowering, laying and jointing RCC pipes in C.M.1:11/2 of following diameters in proper position, grade and alignment at all level as directed by Engineer-in-charge including conveyance from stores to site of work, labour, giving hydraulic testing as per ISI code.***

***Class NP3 Test Pressure 0.7 Kg. / sq. cm.***

***250.00 mm Dia***

***450.00 mm Dia***

***600.0 m Dia***

- (i) In case of collar joint pipes and using required to use jute, bitumen and joint to be filled with cement mortar 1:1 (1 cement:1 fine sand) making 45-degree fillet outside the end of collars and specials to be closed and water tight including satisfactory flow testing after laying etc. complete.
- (ii) In case of rubber ring joint pipe, the pipe shall be laid in such a way than it should be pushed in systematic manner so as to achieve the leak proof joint by using rubber ring as per relevant IS.

The end of joints/collars and specials to be closed and watertight including satisfactory flow testing after laying etc. complete. Item includes conveyance of pipes and rubber ring from any Municipal Store to site of work. (The pipes diameter details as per Schedule-B)

**Note:** One Collar shall be supplied with each full-length plain ended R.C.C. pipe. One rubber ring should be supplied with each full-length socketed pipe, cost including the rate.

**MATERIALS:**

R.C.C. NP3 / NP4 Class spun pipes of various diameters of required length with collars shall be supplied by the contractor as per terms and condition attached herewith at end of this item. Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-6, and Cement mortar of required proportion shall conform to M-11 all the required materials for completing the items shall conform to relevant Indian Standard specification requirements.

Rubber Ring shall confirm to IS: 5382-1985.

**STACKING OF MATERIALS:**

Reasonable care shall be exercised in loading, transporting and unloading of the pipes and specials. Gradual unloading shall be done by inclined plane or by chain block. Handling shall be done such as to avoid impact.

Before, the actual laying of pipeline started, the pipes and fittings in required quantity shall be arranged lengthwise, by the site of the excavated trench without causing any obstacles to the traffic. If necessary, the pipe shall be got cut by the contractor at his own cost to accommodate specials or fittings or for any other reason.

The contractor shall be fully responsible for safety of materials at site.

**LAYING (FOR COLLAR JOINTS):**

Before laying, the trench section shall be got checked for its level and uniform grade as per L-section and plan and finished with proper bedding if required as directed, with the help of sight rails and boning rods and shall be got approved from the Engineer-in-charge.

Drainage pipes are always laid with the socket at the higher and consequently, it is necessary to beginning at the lower end of drains and to work upwards laying pipes shall confirm to I.S. 783-1967 or its latest version.

The contractor shall provide and maintain leveling instruments. The pipes shall be laid in a complete straight line with center lines ranged accordingly by means of string stretched between sight centers of cross rails and no deviation will be permissible between the manholes. The pipe shall be laid from manhole started from the lower end. The bottom concrete of the manhole must be finished simultaneously with laying joints of pipes in that section.

Temporary Benchmark shall be provided by the contractor at a minimum distance of every 150 meters without any extra claim. These B.Ms. shall be either of stone masonry or mass concrete not less than 0.14 Cu.mt. The site of B.M. kept will be directed by the Engineer-in-charge.

The pipe shall be laid in reasonably dry condition and under no circumstances they shall be rest on slushy bedding.

The pipe shall be lowered by means of wooden bull and rope in case of light pipe up to 225 mm dia. while tripped and chain pulley block of sufficient capacity shall be used for heavy pipes above 250 mm dia.

No brick bats or hard stone or kapachi bigger than 20 mm size shall be allowed beneath the pipeline directly in touch with the pipe. Murrum bedding shall be provided if only directed by the Engineer-in-charge.

The pipe shall be laid in such a way that their longitudinal joints shall always come on the top and quite center. The long collar than shall first slipped over after cleaning the ends of pipes. The wedge shape groove at the end of the pipe shall be slipped with required quantity of jute dipped in hot tar or bitumen. The bitumen for this shall be heated till it is sufficiently plastic.

The next pipe shall than be brought forward and pressed till the jute ring in recess of first pipes sets into the recess of the second pipe. The process shall be repeated for two three pipes, which shall than the packed up in usual manner by jack and in doing so, care shall be taken to see that there shall be no deflection from the alignment.

The collar than shall be brought systematically over the ends of pipes and kept equal distance from the pipe with help of ends necessary wedge placed along periphery of collar. The space

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between the inside of collar and outside of the pipe shall be sprinkled with just sufficient water to make into damp condition.

**PREPARATION OF MORTAR:**

Cement mortar of cement and sand shall be prepared in workman like manner in proportion of one (1.0) part of cement with one (1.0) part of sand in volume. First dry mixing shall be carried out and then added sufficient quantity of water to have consistencies of a semi-dry condition, suitable for caulking by caulking tools.

The mortar shall be prepared on clean and watertight platform and in required quantity only and shall be taken in to use before it starts setting. Only fresh mortar shall be used.

**CAULKING:**

The mortar so prepared shall be rammed and well packed and pressed with a caulking tool into the annular space, the caulking shall be so firm that it shall be difficult to drive penknife into. The joint shall be finished off with a fillet sloping 45 degree along with the length of pipe. It shall be finished smooth with cement slurry.

If sub-soil or surface water meet with, the caulking shall be done with near quick setting cement mixed with water proofing compound, the whole caulking job shall be carried out in dry condition till cement joint set No extra payment shall be made on account of such job.

The joints shall be protected until final set, from sub-drying winds, rain and frost.

In no case sub-soil water shall be allowed to rise in or above the pipeline before the cement mortar of joint has set up. Every precaution shall be taken to avoid floating of pipeline due to accumulation of water in the trench while pipeline is empty. No working or walking over the pipe after they are laid shall be allowed. After pipeline is jointed, earth shall be refilled on the sides of the pipeline up to the top of the pipe keeping at least 90 cm length of pipeline open at the joints. The refilling shall be done strictly as per specification of item of refilling of trenches. Care shall be taken to see that after such refilling, joints remain completely opened around till final set and hydraulic/flow test is given and joints are inspected for leakage under pressure.

**CURING OF JOINTS:**

Every joint shall be kept wet for about 10 days for maturing. The section of pipeline jointed shall be covered with wet gunny bags and kept moist continuously for above said curing period.

**LAYING (SPIGOT AND SOCKET RUBBER RING ROLL ON JOINT)**

Boning Staves and Sight Rails:

In various the pipes and fittings/specials the center for each manhole/chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation. So arranged that a sight rail when fixed at a certain level against the post shall cross the center line of the manhole/chamber or pipelines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by Engineer-in-charge.

Boning staves of 75 mm x 50 mm size shall be prepared by contractor in various lengths. Each length being of a certain whole number of meters and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the gross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside. Diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipeline, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the

pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides and the tee heads and cross piece of the boning staves shall be painted black.

For the pipes converging to a manhole / chamber at various levels. There shall be a rail fixed for every different level when a rail comes within 0.50 m of the surface of the ground. A higher sight rail shall be fixed for use with the rail over the next point. The posts and rails shall in no case be removed until the trench is excavated. The pipes are laid and Engineer gives permission to proceed with the backfilling.

laying of Pipes and fittings shall be carefully cleaned before installation. Whenever pipe laying is interrupted for any reason. The open end of the pipeline shall be sealed with a suitable expanding stopper or a properly fitted temporary wooden stopper and exposed pipes shall be suitably protected from stones and other objects falling into the trench from above.

The permissible tolerance for pipelines in trenches shall be 6 mm in level and 25 mm in line between manholes. After the laying of a length of a pipeline but before testing the crown of the pipe shall be checked for level and alignment and any necessary adjustment made by un-jointing and removing the pipes concerned. Adjusting the bedding, relaying the pipes and rechecking for line and level. In addition, where a gravity pipeline is shown on the drawings as being straight between manholes it will not be accepted unless a light can be sighted directly through the length concerned.

For pipeline jointing systems incorporating flexible jointing rings, pipes shall be laid with the spigot and pointing in the direction of flow and with a gap between the end of the spigot and the base of the socket, or between spigots rubber rings shall comply to IS-5382.

#### **Jointing:**

##### **General:**

Pipe section shall be joined utilizing spigot and socket flexible joint with rubber ring, as per IS-783. After jointing extraneous material, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. The rubber sealing rings used for jointing shall conform to IS-5382.

##### **Spigot and Socket Joint (Flexible)**

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings shall be used, and the manufacturer's instructions shall be deemed to form a part of these engineer's requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

#### **HYDRAULIC/FLOW TEST OF PIPES:**

The contractor shall give at his own cost necessary hydraulic/flow test of pipeline laid.

Each section of drain shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to back fill the pipes up to the top, keeping at least 90 cm. length of pipe open at the joints. It is necessary at the pipeline are filled up with water for about a week before commencing the application of pressure to allow for the absorption by pipe wall. Pipes shall be tested after the cement mortar joints have been made.

The line shall be tested as per I.S.8127-1967 (code of practice for laying for glazed stoneware pipes) or its latest edition.

The contractor shall provide at his own testing equipment of approved make. This shall be approved by the Engineer-in-charge.

All pipes, specials, joints found to be leaking or cracked or busted or observed unsuitable shall be removed and repaired. Contractor shall see that no end of any pipe length is kept

open even temporarily and that all open ends are immediately at the end of every day's work covered up either layer gunny bag cloth bided, properly by means of mild steel wires without any claim for extra cost.

Filling above the drains to a depth of twice the diameter of the pipeline shall be completely free from boulders, stones, or brick bats and shall be composed of selected hard variety of murrum well consolidated but not heavily tempered. In the remaining depth, the trench shall be filled up by the selected stuff and murrum as ordered by the Engineer-in-charge.

For crossing of obstacles, natural or built up, such as culvert drains bridges etc. the contractor shall approach respective authorities to obtain permission for crossing them. Such work left remaining to be carried out due to want of permission shall be carried out at any later stage or period within a time to the satisfaction of the Engineer-in-charge.

#### **GENERAL:**

After the satisfactory test of draining line the rubber plugs fitted to Y or T branches shall be taken out and ends shall have to be closed with cement concrete plugs or bricks bats as directed by the Engineer-in-charge. These plugs shall be fixed with mud mortar or cement mortar over the mud mortar of about 6 mm to 12 mm thick shall be plastered. All those works shall be done strictly as per instructions of the Engineer-in-charge. If directed, alternatively the branches of Y or T after fixing plugs shall be properly closed with a place of gunny bag and the same shall be tied with M.S. wire. The rate shall include the cost of all these materials and labour etc. complete.

If pipe-lines are laid in separate detached sections and not in continuous length due to any reasons, such as non-availability of pipes or due to obstacles or due to non-availability of permission etc., the contractor shall complete the work after words at the same rate as originally provided for the tenderer, without any claim for extra or compensation due to non-respect of permission or any other natural or unforeseen reasons and until the date of completion of work, shall be treated as in- complete.

Complete arrangements for water supply requirements for complete construction of work, hydraulic testing and for layout shall be done by the Contractor at his own cost. The water shall potable.

The contractor shall appoint a qualified site supervisor who can take the responsibilities and fixing the inner levels of the drains.

Temporary benchmarks shall be provided and protected by the contractor at a minimum distance of every 150 meter at site without any extra cost. These benchmarks shall be either of masonry or mass concrete or not less than 0.140 Cu.mt. The location of benchmarks shall be kept as directed by the Engineer-in-charge.

The rate includes crossing of all obstacles such as electric wire, telephone cable, water pipes, sewer, drains, manholes walls, culverts, khalkuvas, etc. coming in the laying of pipelines work. Any damage done to this may be restored by the contractor without any extra claim. Any work of removing, repair of such structures or constructed in the process of laying pipelines etc. shall be carried by the contractor without any claim for extra cost. Arrangements for dewatering and cleaning the khalkuvas shall be done by the contractor without any extra claim.

#### **MODE OF MEASUREMENT AND PAYMENT:**

The measurements shall be paid per meter length of the pipeline laid, jointed and tested and measured along the center line and shall be paid according to the inner diameter of the pipes providing and as per the rates quoted by the tender in respective items of Schedule-B.

The pipes may be available in approximate size either in metric system, or British system. No additional payment or reduction in payment will be made for such approximate size.

No extra payment for dewatering or installing dewatering sets for pumping out such water shall be made. No extra payment for collar pits shall be made. No extra payment for cutting of pipes, if required shall be made to the Contractor.

In absence of hydraulic/flow test 20% of the amount of the laying and jointing work of pipeline work will be withheld from the running bills till satisfactory hydraulic test is given. If level for invert of pipes is not maintained by the Contractor 100% payment shall be withheld.

### **Manufacturing of NP3 and NP4 class R.C.C. Pipes and collars.**

#### **1. MATERIALS:**

For precast concrete pipes, materials complying with the requirements given below shall be used.

##### **(A) CEMENT:**

Cement used for the manufacture of unreinforced and reinforced concrete pipes shall conform to I.S. 269-1967 or I.S. 455-1989 or I. S. 1489-1967 or 1489-1976 or IS - 8041-1978 or IS - 8043-1978 or IS - 8112-1976.

##### **(B) AGGREGATES:**

Aggregates used for the manufacture of reinforced concrete pipes shall conform to I.S. 383-1976. The maximum size of aggregate should not exceed one third the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter of 80 to 250 mm the maximum size of aggregate should be 10 mm.

**NOTE:** It is preferable to have the size and grading aggregates conforming to IS-383-1970. It is also preferable that materials finer than 75 micron IS-Sieve are restricted to 3 percent by mass.

##### **(C) REINFORCEMENT:**

Reinforcement used for the manufacture of the reinforced concrete pipes shall be mild steel grade I or medium tensile steel bars conforming to I.S. 432 (Part-I) 1982 or hard drawn steel wire conforming to I. S. 432 (Part-II) 1982 or structural steel (Standard Quality) bars conforming to IS-226-1975 where soft grade wire is used it shall conform to I.S. 280-1978.

##### **(D) CONCRETE OR MORTAR:**

Concrete used for manufacture of reinforced concrete pipes and collars shall conform to I.S. 458-2021.

(a) The concrete for non-pressure pipes shall have a minimum cement concrete of 360 Kg/Cumt. and a minimum compressive strength of 20 N/Sq.mm. at 28 days. If mortar is used it shall have a minimum cement content of 450 Kg/Cu.mt. and a compressive strength not less than 20 N/Sq.mm. at 28 days. The concrete for pressure pipes shall a minimum content of 450 Kg/Cu.mt. and a minimum compressive strength of 25 N/Sq.mm. at 28 days. If mortar is used, it shall have a minimum cement of 600 Kg/Cu.mt. and a compressive strength not less than 25 N/Sq.mm. at 28 days.

Where the process of manufacture is such that the strength the concrete or mortar in the pipe differs from that given by test on cubes the two may be related by a suitable conversion factor. If the purchaser required evidence of this factor, he shall ask for it before placing the order. The conversion factor for 28 days compressive strength for spun concrete may be taken at 1.25 in the absence of any data.

Compressive strength tests shall be conducted on 15 cm cubes in accordance with the relevant requirements of I.S. 456-2000 and I.S. 516-1959. if so required by the purchaser the manufacturer shall give a certificate indicating the quantity of cement in the concrete mix.

### **DESIGN**

#### **REINFORCEMENT:**

The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe and shall be so designed that it may be readily placed and maintained to designed shape and in the proper position within the pipe mould during the manufacturing process. The circumferential and longitudinal reinforcement shall be adequate the satisfy the requirement specified in table 2.

For non-welded lages spiral reinforcement of the same diameter shall be closely spaced at the end of the pipe for a length of 150 mm to minimize damage during handling. The spring of

such end spirals shall not exceed 50 mm or half the pitch whichever is less than such spiral reinforcement at ends shall be part of the total spirals reinforcement specified in different table.

The pitch of the circumferential reinforcement shall be not more than the following:

- (a) 200 mm for pipes of nominal internal diameter 80 to 150 mm.
- (b) 150 mm for pipes of nominal internal diameter 200 to 350 mm.
- (c) 100 mm for pipes of nominal internal diameter 400 and above.

The pitch shall also be not less than the maximum size of aggregate plus the diameter of reinforcement bar used.

If so required by the purchaser, the manufacturer shall give a certificate indicating the details relating to quality quantity and dispersion of steel in the pipe as well as the clear cover to the steel provided in the pipe.

**ENDS OF PIPES:** - The ends of concrete pipes shall be suitable for butt and joints for all classes of pipe. Dimensions of collars shall be according the details given in table-2 the reinforcement for the collars shall be as given in table-2. The end of the collar reinforcement shall have a full ring at both ends and the longitudinal reinforcement shall be proportional to the length of the collar.

TABLE – 1 : Attached Separately

TABLE – 2 : Attached Separately

**COVER:** The minimum clear cover for reinforcement in pipe and collars shall be as given below.

**Barrel thickness Minimum clear cover.**

- 
- (1) Up to and including 25 mm 6
  - (2) Over 25 mm and up to & including 30 mm 8
  - (3) Over 30 mm and up to & including 75 mm 10
  - (4) Over 75 mm 15
  - (5) At the end of longitudinal 5

**3. MANUFACTURE:**

**(A) GENERAL**

The methods of manufacture shall be such that the form and the dimensions of the finished pipe are accurate within the limit specified in Indian Standard No.458. The surface and edges of the pipes shall be well defined and true and their ends shall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforced to avoid breakage during transportation.

**(B) CONCRETE MIXING:**

Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass in uniform in colour and consistency, but in no case shall the mixing be done for less than two minutes.

The concrete shall be placed before setting has commenced. It shall be ensured that the concrete is not dropped freely so as to cause segregation. The concrete shall be consolidated by spinning, vibrating, spinning combined with vibrations, or other appropriate mechanical means.

**(C) REINFORCEMENT CAGES:**

Reinforcement cages for pipes shall extend throughout the pipe barrel and shall be wound round normal collapsible frames or drums. The cages shall consist of spiral or rings and straight of a nailed wire cold drawn wire or mild steel rod and may be circular cages shall be placed symmetrically with the thickness of the pipe wall.

The spiral shall end in a complete ring at both the ends of a pipe.

Pipes having barrel thickness 100 mm and above shall have double reinforcement cage and the amount of spiral steel in the outer cage shall be 75 percentage of the mass of spiral steel

in the inner cage, while the total conform to requirements specified in the relevant table of this standard.

The mass of longitudinal in the outer cage and inner cage should be the same that is equal to half the total mass of longitudinal specified in the relevant tables.

Diagonal reinforcement may be provided in pipes for which the cages are not welded so as to help in binding the cage securely. It shall however be ensured that the clear cover for any reinforcement is not below the limit specified. The diagonal reinforcement is a process requirement and shall not be counted against longitudinal and spiral reinforcement.

It is preferable that single reinforcement case should be located near the inner surface of the pipe with adequate clear cover.

#### **(D) CURING:**

##### **(i) Water Curing:**

Pipes manufactured in compliance with this standard shall be cured by immersion in water for a period of not less than two weeks in case of pipes made from ordinary Portland cement or 43 grade ordinary Portland cement, pipes may be water cured by immersing in water covering with water saturated material or by a system of perforated pipes, mechanical sprinklers porous hose, or by any other approved method that will keep pipe during the specified curing period. In the case of large pipe projecting partly above water level, the projecting portion shall be kept wet by any suitable means.

##### **(ii) Steam Curing:**

Steam curing of concrete pipes may be permitted provided the requirement of pressure and non-pressure steam curing is fulfilled and pipes conform to the requirements of this specification.

#### **WORKMANSHIP AND FINISH:**

Pipes shall be straight and free from cracks excepting craze cracks. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight in the trench on opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive) and 6 mm in pipes larger than 600 mm diameter.

The outside and inside surface of the pipes shall be smooth, dense and hard and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacture or supplier. For better bends inner surface of the collar may be finished rough.

The pipes shall free from defects resulting from imperfect grading of the aggregate mixing or moulding. Pipes shall be free from load bents or bulges greater than 3.00 mm in depth and extending ever a length in any direction greater than twice the thickness of barrel. Pipes may be repaired, if necessary, because of accidental injury during manufacture or handling and shall be accepted if in the opinion of the Corporation the repairs and mould and appropriately finished and cured and the repaired pipe forms to the requirements of this specification.

Deviation from Straight: The deviation in straight in any pipe throughout its effective length, tested by means of rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters 3 mm for every meter run.

#### **TESTING:**

All pipes for testing purpose shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under this standard.

At production of each lot of pipe of each diameter the testing shall be done for each lot of pipes as per I.S. 3597-1998 & 458-2021.

(A) The number of test specimens shall be taken as per table No.1 The following test shall be carried out for each lot.

(1) Three-edge bearing test or load test.

#### **1.1.3 Procedure :**

(2) Hydrostatic test.

(3) Dimensions.

(4) Workmanship & finish.

(1) **Three edge bearing test or load test:**

Load shall be taken as per table 2

**1.1 Apparatus:**

1.1.1 Testing Machine: - Any mechanical or hand-powered device may be used in which the head that applies the load moves at such a speed as to increase the load at a uniform rate of approximately 200 percent of the expected crushing load per liner metre per minute. The loading device shall be calibrated within an accuracy of + / - 2 percent. The testing machine used for the load tests should produce a uniform deflection throughout the full length of the pipe and shall be so substantial and rigid throughout, that the distribution of the test load along the length of the barrel of the pipe will not be appreciably affected by the deform or yielding or any part of the machine during the application of the load lower and upper bearing shall be as per I.S. 3597-1998.

1.1.2 The equipment shall be so designed that the load will be distributed about the center of the overall length of all pipe. The load may be applied either at a single point or at multiple points dependent on the length of the pipe being tested and the rigidity of the test frame.

The specimen shall be placed on the two bottom bearing strings in such a manner that the pipe rests firmly and with the most uniform possible bearing on each strip for the full length of the pipes less the socket portion, if any.

If mutually agreed upon by the manufacturer and the Corporation prior to the test, before the pipe is placed, a fillet of plaster of Paris not exceeding 25 mm in thickness may be cast on the surface of the upper and lower bearings. The width of the fillet cap, top or bottom, shall be not more than 25 mm per 300 mm diameter, but in no case less than 25 mm. .LM 10

1.1.3.2 Each end of the pipe at a point mid-way between the lower bearing strips shall be marked and then diametrically opposite points thereof shall be established. The top bearing block shall be so placed that it contracts the two ends of the pipe at these marks. After placing the specimen in the machine on the bottom strips, the top bearing shall be symmetrically aligned in the testing machine. Load shall be applied at the rate indicated in 1.1 until either the formation of a 0.25 mm wide crack or ultimate strength load, as may be specified, has been reached. If both the 0.25 mm crack and ultimate load are required, the specified rate of loading need not be maintained after the load at 0.25 mm crack has been determined.

1.1.3.3 The 0.25 mm crack load is the maximum load applied to the pipe before a crack having a width of 0.25 mm measured at close intervals, occurs throughout a length of 300 mm or more. The crack shall be considered 0.25 mm in width when the point of the measuring gauge penetrates 1.5 mm at close intervals throughout the specified distance of 300 mm. The ultimate load will be reached when the pipe will sustain no greater load.

1.1.3.4 **Calculation:** The crushing strength in Newton per linear metre of pipe shall be calculated by dividing the total load on the specimen by the nominal laying length.

i **1.1.3 Procedure :**

ii

(2) Hydrostatic test.

(3) Dimensions.

(4) Workmanship & finish.

(1) **Three edge bearing test or load test:**

Load shall be taken as per table 2

**1.1 Apparatus:**

1.1.1 Testing Machine: - Any mechanical or hand-powered device may be used in which the head that applies the load moves at such a speed as to increase the load at a uniform rate of approximately 200 percent of the expected crushing load per liner metre per minute. The

loading device shall be calibrated within an accuracy of  $+ / - 2$  percent. The testing machine used for the load tests should produce a uniform deflection throughout the full length of the pipe and shall be so substantial and rigid throughout, that the distribution of the test load along the length of the barrel of the pipe will not be appreciably affected by the deform or yielding or any part of the machine during the application of the load lower and upper bearing shall be as per I.S. 3597-1998.

1.1.2 The equipment shall be so designed that the load will be distributed about the center of the overall length of all pipe. The load may be applied either at a single point or at multiple points dependent on the length of the pipe being tested and the rigidity of the test frame.

The specimen shall be placed on the two bottom bearing strings in such a manner that the pipe rests firmly and with the most uniform possible bearing on each strip for the full length of the pipes less the socket portion, if any.

If mutually agreed upon by the manufacturer and the Corporation prior to the test, before the pipe is placed, a fillet of plaster of Paris not exceeding 25 mm in thickness may be cost on the surface of the upper and lower bearings. The width of the fillet cap, top or bottom, shall be not more than 25 mm per 300 mm diameter, but in no case less than 25 mm. .LM 10

1.1.3.2 Each end of the pipe at a point mid-way between the lower bearing strips shall be marked and then diametrically opposite points thereof shall be established. The top bearing block shall be so placed that it contracts the two ends of the pipe at these marks. After placing the specimen in the machine on the bottom strips, the top bearing shall be symmetrically aligned in the testing machine. Load shall be applied at the rate indicated in 1.1 until either the formation of a 0.25 mm wide crack or ultimate strength load, as may be specified, has been reached. If both the 0.25 mm crack and ultimate load are required, the specified rate of loading need not be maintained after the load at 0.25 mm crack has been determined.

1.1.3.3 The 0.25 mm crack load is the maximum load applied to the pipe before a crack having a width of 0.25 mm measured at close intervals, occurs throughout a length of 300 mm or more. The crack shall be considered 0.25 mm in width when the point of the measuring gauge penetrates 1.5 mm at close intervals throughout the specified distance of 300 mm. The ultimate load will be reached when the pipe will sustain no greater load.

1.1.3.4 **Calculation:** The crushing strength in Newton per linear metre of pipe shall be calculated by dividing the total load on the specimen by the nominal laying length.

NOTE: - In most machines the total load will include the dead weight of the top bearing plus the load applied by the loading apparatus.

## **2. HYDROSTATIC TEST:**

2.1 **Test Specimen:** The specimens for determination of leakage under internal hydrostatic pressure shall be sound surface dry and full-size pipe.

### **2.2 Procedure:**

2.2.1 The pipe shall be supported in such a way so that the longitudinal axis is approximately horizontal and the exterior surface excepting the supports can be examined readily.

2.2.2 The equipment for making the test shall be such that the specimen under test can be filled with water to the exclusion of air and subjected to the required hydrostatic pressure. Apply hydrostatic pressure to the whole pipe including the portion of socket and rebated joints that is subjected to pressure in the "as laid" condition.

2.2.3 The specimen shall be filled with water and the air expelled. Pressure shall be applied gradually the inside of the pipe until the specified test pressure is reached. The test pressure shall be maintained for 2.5 seconds per millimeter thickness of the pipe.

2.2.4 The specimen under test shall show no signs of leakage either in the barrel or socket. Moisture appearing on the surface of the specimen in the form of patches shall not be considered as leakage. If during the test, beads of water appear on the specimen for an additional period equal to the initial period required for the test and the specimen shall be accepted if the beds do not grow on run.

2.3 The NP3 and NP4 class R.C.C. Pipes shall be capable of withstanding a test pressure of 0.7 Kg/Sq.cm. (7.0 m head)

### 3. DIMENSIONS:

3.1 Pipes :- The internal diameter, wall thickness and length of barrel and collar of pipes, the minimum reinforcements and strength test requirements for the six classes of pipe shall be as specified in Table-2. For collar jointed pipes, effective length shall be 2 mt or 2.50 mt. up to 250 mm nominal diameter pipes and 2.5, 3.0, 3.5 or 4.0 mt. for pipes above 250 mm nominal diameter.

3.2 Tolerances: - The following tolerances shall be permitted:

Dimensions		Tolerances
(A) Overall length	:	+/- 1 percent of standard length.
(B) Internal diameter of pipes or socket		
1) Up to and including 300 mm	:	+/-3 mm
2) Over 300 mm and up to and including 600 mm.	:	+/- 5
3) Over 600 mm and up to and	:	+/- 7 mm including 1200 mm.
4) Over 1200 mm	:	+/- 10 mm
(C) Barrel wall thickness		
1) Up to and including 30 mm	:	+ 2 mm - 1 mm
2) Over 30 mm and up to and including 50 mm.	:	- 1.5 mm + 3 mm
3) Over 50 mm and up to and including 65 mm.	:	+ 4 mm - 2.5 mm
4) Over 65 mm and up to and including 80 mm.	:	+ 6 mm - 3 mm
5) Over 80 mm and up to and including 95 mm.	:	+ 6 mm - 3 mm
6) Over 95 mm	:	+ 7 mm - 3.m mm

### (4) SAMPLING AND INSPECTION:

(A) LOT : In any consignment, all the pipes of same class, same size and belonging to the same mix of concrete shall be grouped together to constitute a lot for ascertaining the conformity of material to the requirements of this specification, samples shall be tested for each lot separately.

The No. of pipes to be selected from the lot shall depend on size of the lot and shall be according to the table below.

#### SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of pipes in lot	FOR REQUIREMENTS UNDER 3 & 4		SAMPLE SIZE FOR TEST EXCLUDING ULTIMATE LOAD TEST
	Sample size	Permissible Number of defectives	
Up to 50	8	0	2
51 to 100	13	1	3
101 to 300	20	2	5
301 to 500	32	3	7
500 and above	50	5	10

### (B) NUMBER OF TESTS AND CRITERIA FOR CONFORMITY:

(i) All the pipes selected according to above table shall be inspected for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.

i The lot shall be declared as conforming to these requirements if the number of defectives found in the sample does not exceed the number of defectives given in Col.3

(iii) The lot having found satisfactory shall be further subjected to the tests except ultimate load test for this purpose, the number of pipes given in Col.4 of above table shall be selected from the lot.

#### (5) MARKING:

The following information be clearly marked on each pipe.

(a) Class of pipe.

(b) Date of manufacture and

(c) Name of manufacturer or his registered trade mark or both.

(d) Dia of pipe.

The above information shall be clearly marked on outside only for pipes up to 350 mm and including 350 mm internal diameter and both outside and inside for pipes above 350 mm internal diameter.

#### Design and strength test requirements of concrete pipes of class NP3.

Reinforced concrete - Medium duty Non-pressure pipes.

Nominal Internal Diameter of pipes	Barrel wall thickness	Reinforcement			Strength test requirements for three edge bear test	
		Longitudinal mild steel or hard drawn steel		Spiral hard drawn Kg./ Linear meter	Load to produce 0.25 mm crack Kn/Linear	Ultimate load Kn/Linear meters
		Minimum	Kg/Linear meter			
1.	2.	3.	4.	5.	6.	7.
80	25	6	0.59	0.17	13.00	19.50
100	25	6	0.59	0.24	13.00	19.50
150	25	6	0.59	0.49	13.70	20.55
200	30	6	0.59	0.68	14.50	21.75
225	30	6	0.59	0.86	14.80	22.20
250	30	6	0.59	1.05	15.00	22.50
300	40	8	0.78	1.53	15.50	23.25
350	75	8	0.78	1.58	16.77	25.16
400	75	8	0.78	1.60	19.16	28.74
450	75	8	0.78	1.90	21.56	32.34
500	75	8	0.78	1.97	23.95	35.93
600	85	8 or 6 + 6	1.18	2.82	28.74	43.11
700	85	8 or 6 + 6	1.18	4.87	33.53	50.30
800	95	8 or 6 + 6	2.66	6.87	38.32	57.48
900	100	6 + 6	2.66	11.55	43.11	64.67
1000	115	6 + 6	2.66	15.70	47.90	71.85
1100	115	6 + 6	2.66	20.42	52.69	79.00
1200	120	8 + 8	3.55	24.74	57.48	86.22
1400	135	8 + 8	3.55	46.21	67.06	100.60
1600	140	8 + 8	3.55	65.40	76.64	114.96
1800	150	12 + 12	9.36	87.10	86.22	129.33
2000	170	12 + 12	9.36	97.90	95.80	143.70

2200	185	12 + 12	9.36	133.30	105.38	158.07
2400	200	12 + 12	14.88	146.61	114.96	172.44
2600	215	12 + 12	14.88	175.76	124.54	186.81

NOTE: 1 : The actual internal diameter is to be declared by the manufacturer and the tolerance is to be applied on the declared diameter.

NOTE: 2 : The longitudinal reinforcement given in this table is valid for pipes up to 2.5 mt effective length for internal diameter of pipe up to 250 mm and upto 3 mt. effective length for higher diameter pipes.

NOTE :3: Concrete for pipes above 1800 mm nominal diameter shall have a minimum compressive strength of 35 N/Sq.mm. at 28 days.

NOTE: 4 : If mild steel is used for spiral reinforcement, the weight specified in col.5 shall be measured to 140/125.

NOTE: 5 : Total mass of longitudinal reinforcement shall be calculated by multiplying the value given in Col. By the length of pipe and then deducting for the cover length provided at the two ends.

#### Design and strength test requirements of concrete pipes of class NP4.

Reinforced concrete - Heavy duty Non-pressure pipes.

Nominal Internal Diameter of pipes	Barrel wall thickness	Reinforcement			Strength test requirements for three edge bear test	
		Longitudinal mild steel or hard drawn steel		Spiral hard drawn Kg. / Linear meter	Load to produce 0.25 mm crack KN/Linear	Ultimate load KN/Linear meters
		Minimum	Kg/Linear meter			
1.	2.	3.	4.	5.	6.	7.
80	25	6	0.59	0.26	22.10	33.15
100	25	6	0.59	0.37	22.10	33.15
150	25	6	0.59	0.76	23.30	34.95
200	30	6	0.59	0.88	24.60	36.90
225	30	6	0.59	1.11	25.20	37.80
250	30	6	0.59	1.35	25.50	38.25
300	40	8	0.78	1.53	26.40	39.60
350	75	8	0.78	1.61	29.80	44.70
400	75	8	0.78	1.97	33.90	50.90
450	75	8	0.78	3.36	36.90	55.30
500	75	8	0.78	5.56	40.00	61.20
600	85	8 or 6 + 6	2.34	8.50	46.30	69.40
700	85	8 or 6 + 6	3.44	12.78	52.20	78.30
800	95	8 or 6 + 6	3.44	16.72	59.30	89.10
900	100	6 + 6	3.44	20.92	66.30	99.40
1000	115	8 + 8	6.04	26.70	72.60	108.90
1100	115	8 + 8	6.04	38.02	80.40	120.60
1200	120	8 + 8	6.04	46.25	88.30	132.40
1400	135	8 + 8	9.36	59.20	99.10	148.65
1600	140	12 + 12	9.36	86.60	109.90	164.85
1800	150	12 + 12	14.88	103.30	120.70	181.05

2000	170	12 + 12	14.88	125.28	131.50	197.25
2200	185	12 + 12	14.88	154.94	142.20	213.30
2400	200	12 + 12	14.88	181.25	155.00	232.50
2600	215	12 + 12	14.88	208.25	166.70	250.00

NOTE: 1 : The actual internal diameter is to be declared by the manufacturer and the tolerance is to be applied on the declared diameter.

NOTE: 2 : The longitudinal reinforcement given in this table is valid for pipes up to 2.5 mt effective length for internal diameter of pipe up to 250 mm and upto 3 mt. Effective length for higher diameter pipes.

NOTE :3: Concrete for pipes above 1800 mm nominal diameter shall have a minimum compressive strength of 35 N/Sq.mm. At 28 days.

NOTE: 4 : If mild steel is used for spiral reinforcement, the weight specified in col.5 shall be measured to 140/125.

NOTE: 5 : Total mass of longitudinal reinforcement shall be calculated by multiplying the value given in Col. By the length of pipe and then deducting for the cover length provided at the two ends.

#### DESIGN REQUIREMENTS OF REINFORCED CONCRETE COLLARS FOR PIPES OF NP3 AND NP4 CLASS

Nominal Internal Diameter of pipes	COLLAR DIMENSIONS			REINFORCEMENTS		
	Minimum caulking space	Minimum thickness	Minimum Length	Longitudi nal or hard drawn Minimum Nos.	Mild steel weight Kg/ collar	Spiral hard drawn steel Kg/ Collar
1.	2.	3.	4.	5.	6.	7
80	13	25	150	6	0.08	0.07
100	13	25	150	6	0.08	0.08
150	13	25	150	6	0.08	0.10
200	13	25	150	6	0.08	0.12
225	13	25	150	6	0.08	0.14
250	13	25	150	6	0.08	0.16
300	16	30	150	8	0.11	0.22
350	19	32	200	8	0.15	0.40
400	19	32	200	8	0.15	0.50
450	19	35	200	8	0.15	0.60
500	19	35	200	8	0.15	0.70
600	19	40	200	8	0.23	1.05
700	19	40	200	8	0.23	1.85
800	19	50	200	8	0.23	2.05
900	19	50	200	8	0.33	2.25
1000	19	55	200	8	0.33	3.09
1100	19	65	200	8	0.33	4.11
1200	19	75	200	12	0.50	5.08
1400	19	80	200	12 or 8 + 8	0.67	6.55
1600	19	90	200	12 or 8 +	0.67	9.00

				8		
1800	19	100	200	12+12	1.00	12.15
2000	19	110	200	12+12	1.00	13.30

NOTE: 1 : Collars for sizes 2200 mm and above shall be made out of mild steel plate of 6 mm thickness, steel conforming to IS:226-1975 with outside painted.

NOTE: 2 : If mild steel is used for spiral reinforcement, the weight specified in Co.7 shall be increased by factor 140/125.

NOTE: 3 : Soft grade mild steel wire for spirals may be used for collars of pipes of internal diameter up to 150 mm only by increasing weight by a factor 140/84.

#### DESIGN AND STRENGTH TEST REQUIREMENTS OF PIPES OF CLASS NP2 REINFORCED CONCRETE LIGHT-DUTY, NON-PRESSURE PIPES.

Internal Diameter of pipe	Barrel Dimension		Collar Dimension			Longitudinal mild steel at permissible stress of 1.265 Kg/SQ.Ca.	Spiral		Strength test requirement			
	Length	Minimum thickness	Minimum caulking	Minimum thickness	Minimum length		A Hard drawn steel wire at permitted stress of 1400 Kg/Sq.cm	Soft grade mild steel wire permitted stress of 840 Kg/Sq.cm	Load to produce 0.25 mm crack	ultimate load	Load to produce 0.25 mm crack (Sand bearing test)	Ultimate load
1	2	3	4	5	6	7	8	9	10	11	12	13
mm	mm	mm	mm	mm	mm	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m
80	2.0	25	13	25	150	0.863	0.083	0.138	1.040	1.560	1.560	2.340
100	2.0	25	13	25	150	0.863	0.166	0.277	1.040	1.560	1.560	2.340
150	2.0	25	13	25	150	0.86.	0.219	0.365	1.040	1.560	1.560	2.340
200	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
225	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
250	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
300	2.0 or 2.5 or 3.0	30	16	30	150	1.00	1.295	-	1.200	1.800	1.800	2.700
350	2.0 or 2.5 or 3.0	32	16	32	150	1.00	1.750	-	1.200	1.800	1.800	2.700
400	2.0 or 2.5 or 3.0	32	16	32	150	1.00	2.250	-	1.360	1.040	2.040	3.060
450	2.0 or	35	19	35	200	1.00	2.750	-	1.480	2.220	2.220	3.330

	2.5 or 3.0											
500	2.5 or 3.0	35	19	35	200	1.25	3.220	-	1.660	2.490	2.490	3.735
600	2.5 or 3.0	40	19	40	200	1.25	4.90	-	1.900	2.850	2.850	4.275
700	2.5 or 3.0	40	19	40	200	1.78	6.05	-	2.100	3.150	3.150	4.725
800	2.5 or 3.0	45	19	45	200	1.78	9.10	-	2.300	3.450	3.450	5.170
900	2.5 or 3.0	50	19	50	200	1.78	11.35	-	2.500	3.750	3.750	4.625
1000	2.5 or 3.0	55	19	55	200	2.50	13.50	-	2.650	4.020	4.020	6.030
1200	2.5 or 3.0	65	19	65	200	2.50	18.20	-	2.880	4.320	7.320	6.480
1400	2.5 or 3.0	75	19	75	200	3.36	22.60	-	2.980	4.470	4.70	6.705
1600	2.5 or 3.0	80	19	80	200	3.36	28.30	-	2.980	4.470	4.470	6.705
1800	2.5 or 3.0	92	19	90	200	3.36	36.00	-	2.980	4.470	4.470	6.70

NOTE:- If steel wires are used as longitudinal reinforcement, the weight specified in Column 7 shall be modified by a factor  $1\ 265/1\ 400$ .

NOTE:- If mild steel is used for spiral reinforcement, the weight specified under Column 8 shall be increased to  $1\ 400/1\ 265$ .

NOTE:- Use of soft grade mild steel wire for spiral reinforcement is not recommended for pipes of internal diameter larger than 150 mm.

#### **TERMS AND CONDITIONS OF CONTRACT FOR SUPPLYING NP3 AND NP4 CLASS SPIGOT SOCKET FLUSH TYPE RUBBER RING JOINTS R.C.C. PIPES AND SPECIALS**

1. The pipes and special mentioned in Schedule 'B' attached herewith shall be delivered on site as shown by the Executive Engineer, South Zone A (Udhana) or stacked in the Company's premises till required by the Executive Engineer, South Zone A (Udhana).
2. The rates per meter for the supply of pipes of different categories shall include the cost of necessary collars requires to be supplied along with each pipe length and specials. The collars shall be machine moulded. Hand moulded collars shall not be accepted.
3. The company will have to make their own arrangement for procuring steel and wire etc. required for the said works. The company shall neither claim any rise in rates due to any causes whatever for the supply of pipes and specials mentioned in schedule under Para (1) Nor shall the Municipal Corporation claim and reduction in rates for the same due to any causes whatsoever.
4. The pipes etc. shall manufactured to the I.S. specification 458- 2021 with the latest amendments of 1991.
5. At production of each lot of pipe of each size, the Contractor shall send the letter of offer for testing of pipes of Executive Engineer, South Zone A (Udhana). The authorized representative of Executive Engineer, South Zone A (Udhana) shall test the pipes as per I.S. 3597-1998 & I.S. 458-2021 with latest amendments.
6. The Contractor shall use the reinforcement as specified in I.S. 458-2021 with latest amendment. 2% of the pipes may be broken to ascertain the weight of steel and if not found

in accordance with I.S. Specification the whole lot shall be rejected or the payment shall be made at the reduced rate as settled by the Commissioner, S.M.C. The cost on the pipe broken for inspection shall be born by the Contractor in any case.

7. The successful tenderer shall deposit a sum equal to 2% of the tendered amount with the Surat Municipal Corporation for due fulfillment of various terms and conditions of contract and the same shall be returned to the company on presentation of certificate from the Executive Engineer, South Zone A (Udhana) that the terms and conditions of the contract has been fulfilled.

8. If the company do not abide by any of the terms of the agreement, the Municipal Corporation will have the right to cancel the contract by giving 15 days' notice and the amount of 2% of Security Deposit shall be forfeited to the Municipal Corporation for the breach of the contract. The company shall further be liable to pay extra cost that right be incurred by the Municipal Corporation for the purchase of pipe and specials from any other source.

9. The Municipal Corporation is at liberty to curtail the quantity of pipes of each category as per the requirements.

10. The pipes shall have to be supplied within the time as shown in Memorandum (Failing which the Municipal Corporation shall be at liberty to penalty clause. The time limit shown in memorandum status from the date of placing order.

**TABLE-14: SPIGOT AND SOCKET DIMENSIONS OF NP2 AND NP3 CLASS PIPES (RUBBER RING ..... ON JOINT) FROM 80 TO 900 MM DIAMETER**

Pip e dia.	Ru bb er rin g ch art dia.	Rub ber ring int. dia.	T	RS	D S	D S1	D S2	D S3	R	LS D	K	N	LT	HT	LS P	P	S	H	X	W	RI
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	230	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
225	11	255	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
250	11	275	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
300	12	340	40	51	90	12	42	36	6	7	7	130	130	53	55	7.5	6	34	1	1	6
350	16	435	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
400	16	480	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
450	16	575	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
500	16	570	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
600	20	625	85	85	150	20	70	60	10	12	12	193	153	88.5	90	12	10	75	2	2	10

700	20	765	85	85	15 0	20	70	60	10	12	12	19 3	15 3	88. 5	90	12	10	75	2	2	10
800	20	875	95	95	15 0	20	70	60	10	12	12	19 7	17 1	98. 5	90	12	10	85	2	2	10
900	20	970	10 0	100	15 0	20	70	60	10	12	12	20 0	18 0	10 3.5	90	12	10	90	2	2	10
900	20	970	10 0	100	15 0	20	70	60	10	12	12	20 0	18 0	10 3.5	90	12	10	90	2	2	10

ALL DIMENSIONS IN MILLIMETERS

NOTE:-

1. Corners to be rounded off.
2. The dimensions DS2, DS3, LSP, IS, T, H, S, HT and K shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerance shall supply on the critical dimensions.

### Dimensions Tolerances

**T and GT same as that of barrel wall thickness given in 8.2**

**TS and H half the tolerance on barrel wall thickness given in 8.2**

**DS2, DS3, K & S The tolerance, in mm shall be as given below:**

Chard Diameter	DS2	DS3	LSP	K	S
10	12	+/-3	+/-4	+/-1.25	+/-0.75
12	12	+/-3	+/-4	+/-1.25	+/-0.75
16	12.5	+/-3	+/-4	+/-2.00	+/-1.25
20	13	+/-3	+/-4	+/-2.25	+/-1.55

**TABLE-17: SPIGOT AND SOCKET DIMENSIONS OF NP3 / NP4 CLASS PIPES FROM 1000 TO 2600 MM DIAMETER (RUBBER RING CONFINED JOINT)**  
ALL DIMENSIONS IN MILLIMETRES

Pipe Dia-meter	Rubber ring chart dia-meter	Rubber ring internal diameter	T	TS	LS	LSI	K	LSP	a	b	j	H	i	l	iD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1100	20	920	115	58.0	114	20	13	114	25	28	39	42	4	9	1100
1100	20	1009	115	58.0	114	20	13	114	25	28	39	42	4	9	1202
1200	20	1095	120	60.5	114	20	13	114	25	28	39	44.5	4	9	1307
1400	25	1275	135	67.5	114	20	16	114	25	35	42.5	50	4	10	1520
1600	25	1445	140	72.5	114	25	16	114	25	35	42.5	50	4	10	1720
1800	25	1620	150	77.5	114	25	16	114	25	35	42.5	55	4	10	1930
2000	25	1810	170	87.5	114	25	16	114	25	35	42.5	65	4	10	2150
2200	25	1995	185	95.0	114	25	16	114	25	35	42.5	72.5	4	10	2365
2400	25	2180	200	102.5	114	25	16	114	25	35	42.5	87.5	4	10	2580
2600	25	2360	215	110.0	114	25	16	114	25	35	42.5	87.5	4	10	2995

## NOTES:

1. Corners to be rounded off.
2. The dimensions LS, LSP, TS, T, H, L, b and K shall conform to the values given in this table as these are critical dimensions. Outer dimensions are for guidance only. The following tolerance shall apply on the critical dimensions.

## Dimensions Tolerances

LS and LSP +7 mm

T Same as that of barrel wall thickness given in 8.2

H and TS Half the tolerance on barrel wall thickness given  
In 8.2

L +0.5 MM

b +1 mm for 28 mm and +1.5 mm for 35 mm

K +1.75 mm for 20 mm rubber ring chord dimensions  
+2.5 mm for 25 mm rubber ring chord dimensions**TABLE-20 WEIGHT OF SPIRALS (HARD DRAWN STEEL) IN SOCKET OF R/R JOINT**

R.C.C. PIPES OF DIFFERENT CLASSES (Kg./Number)

Internal diameters of pipes	NP2 Class	NP3 Class	NP4 Class	P1 Class	P2 Class	P3 Class
1.	2.	3.	4.	5.	6.	7.
80	0.08	0.08	0.08	0.08	0.08	0.08
100	0.09	0.09	0.09	0.09	0.09	0.09
150	0.12	0.12	0.12	0.12	0.12	0.15
200	0.14	0.14	0.21	0.14	0.21	0.35
225	0.15	0.15	0.26	0.15	0.26	0.43
250	0.16	0.16	0.31	0.16	0.31	0.51
300	0.45	0.45	0.53	0.45	0.53	0.84
350	0.51	0.64	0.64	0.51	0.74	1.24
400	0.56	0.71	0.71	0.56	0.99	1.66
450	0.63	0.76	0.76	0.63	1.23	2.26
500	0.68	0.87	1.08	0.68	1.57	2.85
600	0.81	1.00	2.12	1.52	2.88	4.74
700	0.92	2.16	3.02	1.79	3.96	6.79
800	1.14	2.87	4.67	2.04	6.28	9.99
900	1.50	4.06	6.03	2.63	8.29	-
1000	1.91	-	-	3.33	1.29	-
1100	2.34	-	-	4.08	-	-
1200	2.84	-	-	4.90	-	-
1400	3.82	-	-	-	-	-
1600	5.64	-	-	-	-	-
1800	7.25	-	-	-	-	-
2000	11.78	-	-	-	-	-
2200	12.88	-	-	-	-	-

## NOTES:

1. Longitudinal reinforcement shall be proportional to be the length of socket cage as given in Tables 2 to 11.

2. If mild steel is used for spiral reinforcement, the weight specified above shall be increased to 140/125.

#### SPECIFICATION FOR RUBBER RINGS FOR SEWERS: INDIAN STANDARD: 5382-1985

##### 1. SCOPE:

1.1 This standard prescribes the requirements for materials used for vulcanized solid rubber sealing rings for water supply and drainage system, drain pipes, sewers and rainwater pipes, all at ambient temperature including gas connections. It covers joint rings for all pipe line materials including iron, steel, stoneware, asbestos cement concrete, pitch fiber, plastics and glass reinforced plastics.

##### 2. TYPES:

2.1 This standard covers six types of pipe joint rings, namely, 1 to 6. These correspond to the respective nominal hardness of 40, 50, 60, 70, 80 and 88 IRHD.

2.2 Sealing rings having two different types of rubber are permitted.

##### 3. REQUIREMENTS.

3.1 Material: The rubber shall be free from extractable substances which impart taste, odour of toxicity of water.

3.2 The rings shall be homogeneous, free from porosity, grit, excessive blooms, blisters or other visible surface imperfections.

3.3 Stretch Test: Stretch gaskets till the circumference is increased by 50 percent, then visually inspect for the following.

3.3.1 Gaskets shall be made of a properly vulcanized virgin rubber compound containing no scrap or reclaim.

3.2.2 The surface of the gasket shall be smooth free from pitting cracks, blisters, air marks, and any other imperfection that may affect its behavior in service. The body of the gasket shall be free from porosity and air pockets.

3.4 Unless otherwise specified, the materials shall be black.

3.5 Dimensions and Tolerances - All the dimensions and tolerances shall be as agreed to between the purchaser and the manufacturer/supplier.

##### 3.6 Physical Requirements:

3.6.1 Hardness: Hardness when determined in accordance with Micro test method described in IS: 3400 (Part-I)-1980 (Methods of test for vulcanized rubber: Part-2 Hardness.). Hardness when determined in accordance with micro test method described in IS-3400 (Part-II) 1980 shall comply with the requirements given in Table-1. If the Dimensions of the ring are appropriate than 'Normal Test Method' specified in IS3400 (Part-II) 1980 may be used provided that the 'Micro Test Method' is used for reference purpose.

3.6.2 Tensile Strength and Elongation at Break: Determined by the method described in IS:3400 (Part-1)-1977 [Methods of test for vulcanized rubber : Part-1 Tensile stress-strain properties (first revision)].

3.6.3 Compression Set: Determined by the method described in IS: 3400 (Part-10)-1977. [Methods of test for vulcanized rubber: Part-10 Compression set at constant strain (first revision)]

3.6.4 Accelerated Ageing in Air: By the oven method described in IS-3400 (Part-4)-1983, the changes in hardness, tensile strength and elongation at break after ageing shall comply.

3.6.5 Water Immersion: Determined according to the method given in IS-3400(Part-6)-1983 after 7 days immersion in neutral water pH 7 at 70°C.

3.6.6 Cold Resistance: When cooled in a chamber described in Appendix-B (IS-5382-1985), the increase in hardness, measured after 7 days at - 10°C, from the initial hardness, shall comply with the requirements given in as per IS.

3.6.7 Water Absorption: Sealing rings shall not absorb more than 10 percent (m/m) of water when tested according to the method prescribed in relevant IS.

**4. MARKING:**

4.1 Each sealing ring or packing or both shall be marked indelibly with:

- (a) The manufacturer's name or trade-mark, if any;
- (b) The month and year of manufacture; and
- (c) The type following by a word, such a 'Gas' or 'Water' or 'Sewers' depending on the application for which they are intended.

4.1.1 Each sealing ring or packing or both may also be marked with the Standard Mark.

Note: The use of the standard mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and regulations made there under. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing, and quality control which is devised and supervised by BIS and operated by BIS for conformity to that standard as a further safeguard. Details of conditions under which a license for the use of the Standard Mark may be obtained from the Bureau of Indian Standards.

**5. PACKING:**

5.1 The material shall be packed as agreed to between the purchaser and the supplier so as to protect them from undue exposure to light and heat and mechanical damages during transit and storage.

**6. SAMPLING:**

6.1 Scale of Sampling and Criteria for Conformity: For the purpose of ascertaining conformity to this standard the scale of sampling and criteria for conformity shall be as prescribed as per relevant I.S.

**7. TIME LAPSE BETWEEN RECEIPT OF MATERIAL AND TESTING:**

7.1 For all the test purposes, the minimum time between vulcanization and testing shall be 16 h.

7.1.1 For product tests, whenever possible, the time between vulcanization and testing should not exceed 4 months. In other cases, tests shall be made within 2 months from the date of receipt of the product by the customer.

**8. TEST PIECE:**

8.1 Wherever possible, for all tests, test pieces shall be cut from the finished article. Where this is not possible, the manufacturer shall provided test slabs from the same batch of rubber and vulcanized to the same degree and in the same manner as that of the rubber from which the sealing rings have been manufactured.

8.1.1 Wherever it is not possible to cut standard test piece from the rings, for determination of tensile strength and elongation at break, test piece as shown in drawing shall be used with the rate of traverse of moving grip as 15 cm/min.

**APPENDIX-C**

(Clause 3.7.8)

**WATER ABSORPTION****C.1 PROCEDURE:**

C.1.1 From the finished ring cut a piece of about 3 g. Weigh it accurately. Put in 150 ml of distilled water. Boil under reflux with air condenser for 168 hours. Remove the piece and weigh again after surface water layer is dried up.

**C.2 CALCULATION:**

C.2.1 Calculate the water absorption as follows:

$$M_2 - M_1$$

$$\text{Water absorption, percent by mass} = \frac{\text{-----}}{M_1} \times 100$$

Where

M1=original mass in g of the test piece before immersion in water and

M2 = mass in g of the test piece after immersion in water.

For prescribed limit see-3.6.7

## APPENDIX-D

(Clause 6.1)

## SAMPLING AND CRITERIA FOR CONFORMITY:

## D.1 SCALE OF SAMPLING:

D.1.1 Lot - In a consignment all the sealing rings of the same type, dimensions, design and manufactured from the same type of rubber under essentially similar conditions of production shall be grouped together to constitute a lot.

D.1.2 Samples shall be selected and tested from each lot separately for ascertaining its conformity or otherwise to the requirements of this specification.

D.1.3 The number of sealing rings to be selected at random from a lot for different tests shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table-3

TABLE-3 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of sealing rings in the lots	For diamensions and finishing defects (see 3.2 and 3.3		No. of tests for each characteristic for hardness, tensile strength, elongation compression test set, water absorption and stretch tests	No. of tests for each characteristic for ageing and water immersion test (Table:1 & 2
	Sample size	Permissible No. of defective		
Upto 100	5	0		
101- 150	8	0	3	1
151 - 300	13	0		
300 - 500	20	0		
501 - 1000	32	1	5	2
1001 and above	50	3	8	3

D.1.3.1 The rings to be selected from the lot shall be chosen at random. In order to ensure the randomness of selection, random number tables shall be followed. In case random number tables are not available, the rings may be selected from the lot in the following manner:

Starting from any ring in the lot, the rings shall be counted as 1.2.....r and so on in one order, where r is the integral part of  $N/n$  (N and n being the lot size and sample size respectively). Every ring thus counted shall be withdrawn to constitute the sample.

D.1.3.2 If the rings are packed in bundles, at least 10 percent of the bundles shall be opened and the required number of rings shall be selected by taking approximately equal number of rings at random from each of the bundle.

## D.2 NUMBER OF TEST AND CRITERIA AND CONFORMITY:

D.2.1 All the sealing rings selected according to D.1.3 shall be examined for dimensions and finishing defects. Any ring failing in one or more of these characteristics shall be considered as defective. If the number of defectives found in the sample is less than or equal to the corresponding permissible number given in col-3 of Table-3, the lot shall be declared as conforming to these requirements, otherwise not.

D.2.1.1 In the case of those lots when have been found unsatisfactory according to D.2.1 all the sealing ring may depending upon the agreement between the purchaser and the supplier, be inspected for these characteristics and the defective ones removed.

D.2.2 The lot having been found satisfactory for workmanship and dimensions according to D.2.1 shall then be examined for hardness, tensile strength, elongation strength, swelling, water absorption and compression characteristics. The number of tests to be conducted for such of these characteristics is given in col-4 of Table-3. For this purchase, required number

of rings shall be selected at random from those already selected under D.1.3 and if necessary, from the lot. For each of the characteristics the various tests shall be conducted on independent test pieces. The lot shall be declared as satisfactory if the medium value of the test results of compression characteristic satisfies the relevant requirements and for the remaining characteristics none of test fails.

D.2.3 The lot which has been found satisfactory according to D.2.2 shall then be subjected to relevant ageing and oil immersion tests. The number of independent tests to be conducted for each of the characteristics is given in col-5 of Table-3. For this purpose, required number of rings shall be selected from those which have been tested and found satisfactory under D-2.2. The lot shall be declared satisfactory with respect to ageing characteristic if none of the test fails.

***Item No: 7.12 Providing and Supplying ISI standard R.C.C.pipes***

***7.12 Providing and Supplying ISI standard R.C.C.pipes (of Sulphate Resisting Cement) in standard lengths of following class and diameter suitable for either collar joints or rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to department stores, stacking etc. complete. (IS 458 / 1989) Note: One collar should be supplied with each full length plainended RCCpipe, cost included in rates below. One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.***

***Lowering, laying and jointing RCC pipes in C.M. 1:1 1/2 of following diameters inproper position, grade and alignment at all level as directed by Engineer-in-charge including conveyance from stores to site of work, labour, giving hydraulic testing as per ISI code.***

***Class IRS / NP4***

***250.00 mm Dia***

***400.00 mm Dia***

***600.00 mm Dia***

- (iii) In case of collar joint pipes and using required to use jute, bitumen and joint to be filled with cement mortar 1:1 (1 cement:1 fine sand) making 45-degree fillet outside the end of collars and specials to be closed and water tight including satisfactory flow testing after laying etc. complete.
- (iv) In case of rubber ring joint pipe, the pipe shall be laid in such a way than it should be pushed in systematic manner so as to achieve the leak proof joint by using rubber ring as per relevant IS.

The end of joints/collars and specials to be closed and watertight including satisfactory flow testing after laying etc. complete. Item includes conveyance of pipes and rubber ring from any Municipal Store to site of work. (The pipes diameter details as per Schedule-B)

**Note:** One Collar shall be supplied with each full-length plain ended R.C.C. pipe. One rubber ring should be supplied with each full-length socketed pipe, cost including the rate.

**MATERIALS:**

R.C.C. NP3 / NP4 Class spun pipes of various diameters of required length with collars shall be supplied by the contractor as per terms and condition attached herewith at end of this item. Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-6, and Cement mortar of required proportion shall conform to M-11 all the required materials for completing the items shall conform to relevant Indian Standard specification requirements.

Rubber Ring shall confirm to IS: 5382-1985.

**STACKING OF MATERIALS:**

Reasonable care shall be exercised in loading, transporting and unloading of the pipes and specials. Gradual unloading shall be done by inclined plane or by chain block. Handling shall be done such as to avoid impact.

Before, the actual laying of pipeline started, the pipes and fittings in required quantity shall be arranged lengthwise, by the site of the excavated trench without causing any obstacles to the traffic. If necessary, the pipe shall be got cut by the contractor at his own cost to accommodate specials or fittings or for any other reason.

The contractor shall be fully responsible for safety of materials at site.

**LAYING (FOR COLLAR JOINTS):**

Before laying, the trench section shall be got checked for its level and uniform grade as per L-section and plan and finished with proper bedding if required as directed, with the help of sight rails and boning rods and shall be got approved from the Engineer-in-charge.

Drainage pipes are always laid with the socket at the higher and consequently, it is necessary to beginning at the lower end of drains and to work upwards laying pipes shall confirm to I.S. 783-1967 or its latest version.

The contractor shall provide and maintain leveling instruments. The pipes shall be laid in a complete straight line with center lines ranged accordingly by means of string stretched between sight centers of cross rails and no deviation will be permissible between the manholes. The pipe shall be laid from manhole started from the lower end. The bottom concrete of the manhole must be finished simultaneously with laying joints of pipes in that section.

Temporary Benchmark shall be provided by the contractor at a minimum distance of every 150 meters without any extra claim. These B.Ms. shall be either of stone masonry or mass concrete not less than 0.14 Cu.mt. The site of B.M. kept will be directed by the Engineer-in-charge.

The pipe shall be laid in reasonably dry condition and under no circumstances they shall be rest on slushy bedding.

The pipe shall be lowered by means of wooden bull and rope in case of light pipe up to 225 mm dia. while tripped and chain pulley block of sufficient capacity shall be used for heavy pipes above 250 mm dia.

No brick bats or hard stone or kapachi bigger than 20 mm size shall be allowed beneath the pipeline directly in touch with the pipe. Murrum bedding shall be provided if only directed by the Engineer-in-charge.

The pipe shall be laid in such a way that their longitudinal joints shall always come on the top and quite center. The long collar than shall first slipped over after cleaning the ends of pipes. The wedge shape groove at the end of the pipe shall be slipped with required quantity of jute dipped in hot tar or bitumen. The bitumen for this shall be heated till it is sufficiently plastic.

The next pipe shall than be brought forward and pressed till the jute ring in recess of first pipes sets into the recess of the second pipe. The process shall be repeated for two three pipes, which shall than the packed up in usual manner by jack and in doing so, care shall be taken to see that there shall be no deflection from the alignment.

The collar than shall be brought systematically over the ends of pipes and kept equal distance from the pipe with help of ends necessary wedge placed along periphery of collar. The space between the inside of collar and outside of the pipe shall be sprinkled with just sufficient water to make into damp condition.

**PREPARATION OF MORTAR:**

Cement mortar of cement and sand shall be prepared in workman like manner in proportion of one (1.0) part of cement with one (1.0) part of sand in volume. First dry mixing shall be carried out and then added sufficient quantity of water to have consistencies of a semi-dry condition, suitable for caulking by caulking tools.

The mortar shall be prepared on clean and watertight platform and in required quantity only and shall be taken in to use before it starts setting. Only fresh mortar shall be used.

**CAULKING:**

The mortar so prepared shall be rammed and well packed and pressed with a caulking tool into the annular space, the caulking shall be so firm that it shall be difficult to drive penknife

into. The joint shall be finished off with a fillet sloping 45 degree along with the length of pipe. It shall be finished smooth with cement slurry.

If sub-soil or surface water meet with, the caulking shall be done with near quick setting cement mixed with water proofing compound, the whole caulking job shall be carried out in dry condition till cement joint set No extra payment shall be made on account of such job.

The joints shall be protected until final set, from sub-drying winds, rain and frost.

In no case sub-soil water shall be allowed to rise in or above the pipeline before the cement mortar of joint has set up. Every precaution shall be taken to avoid floating of pipeline due to accumulation of water in the trench while pipeline is empty. No working or walking over the pipe after they are laid shall be allowed. After pipeline is jointed, earth shall be refilled on the sides of the pipeline up to the top of the pipe keeping at least 90 cm length of pipeline open at the joints. The refilling shall be done strictly as per specification of item of refilling of trenches. Care shall be taken to see that after such refilling, joints remain completely opened around till final set and hydraulic/flow test is given and joints are inspected for leakage under pressure.

#### **CURING OF JOINTS:**

Every joint shall be kept wet for about 10 days for maturing. The section of pipeline jointed shall be covered with wet gunny bags and kept moist continuously for above said curing period.

#### **LAYING (SPIGOT AND SOCKET RUBBER RING ROLL ON JOINT)**

Boning Staves and Sight Rails:

In various the pipes and fittings/specials the center for each manhole/chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation. So arranged that a sight rail when fixed at a certain level against the post shall cross the center line of the manhole/chamber or pipelines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by Engineer-in-charge.

Boning staves of 75 mm x 50 mm size shall be prepared by contractor in various lengths. Each length being of a certain whole number of meters and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the gross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside. Diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipeline, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides and the tee heads and cross piece of the boning staves shall be painted black.

For the pipes converging to a manhole / chamber at various levels. There shall be a rail fixed for every different level when a rail comes within 0.50 m of the surface of the ground. A higher sight rail shall be fixed for use with the rail over the next point. The posts and rails shall in no case be removed until the trench is excavated. The pipes are laid and Engineer gives permission to proceed with the backfilling.

laying of Pipes and fittings shall be carefully cleaned before installation. Whenever pipe laying is interrupted for any reason. The open end of the pipeline shall be sealed with a

suitable expanding stopper or a properly fitted temporary wooden stopper and exposed pipes shall be suitably protected from stones and other objects falling into the trench from above.

The permissible tolerance for pipelines in trenches shall be 6 mm in level and 25 mm in line between manholes. After the laying of a length of a pipeline but before testing the crown of the pipe shall be checked for level and alignment and any necessary adjustment made by un-jointing and removing the pipes concerned. Adjusting the bedding, relaying the pipes and rechecking for line and level. In addition, where a gravity pipeline is shown on the drawings as being straight between manholes it will not be accepted unless a light can be sighted directly through the length concerned.

For pipeline jointing systems incorporating flexible jointing rings, pipes shall be laid with the spigot and pointing in the direction of flow and with a gap between the end of the spigot and the base of the socket, or between spigots rubber rings shall comply to IS-5382.

### **Jointing:**

General:

Pipe section shall be joined utilizing spigot and socket flexible joint with rubber ring, as per IS-783. After jointing extraneous material, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. The rubber sealing rings used for jointing shall conform to IS-5382.

### **Spigot and Socket Joint (Flexible)**

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings shall be used, and the manufacturer's instructions shall be deemed to form a part of these engineer's requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

### **HYDRAULIC/FLOW TEST OF PIPES:**

The contractor shall give at his own cost necessary hydraulic/flow test of pipeline laid.

Each section of drain shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to back fill the pipes up to the top, keeping at least 90 cm. length of pipe open at the joints. It is necessary at the pipeline are filled up with water for about a week before commencing the application of pressure to allow for the absorption by pipe wall. Pipes shall be tested after the cement mortar joints have been made.

The line shall be tested as per I.S.8127-1967 (code of practice for laying for glazed stone-ware pipes) or its latest edition.

The contractor shall provide at his own testing equipment of approved make. This shall be approved by the Engineer-in-charge.

All pipes, specials, joints found to be leaking or cracked or busted or observed unsuitable shall be removed and repaired. Contractor shall see that no end of any pipe length is kept open even temporarily and that all open ends are immediately at the end of every day's work covered up either layer gunny bag cloth bided, properly by means of mild steel wires without any claim for extra cost.

Filling above the drains to a depth of twice the diameter of the pipeline shall be completely free from boulders, stones, or brick bats and shall be composed of selected hard variety of murrum well consolidated but not heavily tempered. In the remaining depth, the trench shall be filled up by the selected stuff and murrum as ordered by the Engineer-in-charge.

For crossing of obstacles, natural or built up, such as culvert drains bridges etc. the contractor shall approach respective authorities to obtain permission for crossing them. Such work left remaining to be carried out due to want of permission shall be carried out at any later stage or period within a time to the satisfaction of the Engineer-in-charge.

**GENERAL:**

After the satisfactory test of draining line the rubber plugs fitted to Y or T branches shall be taken out and ends shall have to be closed with cement concrete plugs or bricks bats as directed by the Engineer-in-charge. These plugs shall be fixed with mud mortar or cement mortar over the mud mortar of about 6 mm to 12 mm thick shall be plastered. All those works shall be done strictly as per instructions of the Engineer-in-charge. If directed, alternatively the branches of Y or T after fixing plugs shall be properly closed with a place of gunny bag and the same shall be tied with M.S. wire. The rate shall include the cost of all these materials and labour etc. complete.

If pipe-lines are laid in separate detached sections and not in continuous length due to any reasons, such as non-availability of pipes or due to obstacles or due to non-availability of permission etc., the contractor shall complete the work after words at the same rate as originally provided for the tenderer, without any claim for extra or compensation due to non-respect of permission or any other natural or unforeseen reasons and until the date of completion of work, shall be treated as in- complete.

Complete arrangements for water supply requirements for complete construction of work, hydraulic testing and for layout shall be done by the Contractor at his own cost. The water shall potable.

The contractor shall appoint a qualified site supervisor who can take the responsibilities and fixing the inner levels of the drains.

Temporary benchmarks shall be provided and protected by the contractor at a minimum distance of every 150 meter at site without any extra cost. These benchmarks shall be either of masonry or mass concrete or not less than 0.140 Cu.mt. The location of benchmarks shall be kept as directed by the Engineer-in-charge.

The rate includes crossing of all obstacles such as electric wire, telephone cable, water pipes, sewer, drains, manholes walls, culverts, khalkuvas, etc. coming in the laying of pipelines work. Any damage done to this may be restored by the contractor without any extra claim. Any work of removing, repair of such structures or constructed in the process of laying pipelines etc. shall be carried by the contractor without any claim for extra cost. Arrangements for dewatering and cleaning the khalkuvas shall be done by the contractor without any extra claim.

**MODE OF MEASUREMENT AND PAYMENT:**

The measurements shall be paid per meter length of the pipeline laid, jointed and tested and measured along the center line and shall be paid according to the inner diameter of the pipes providing and as per the rates quoted by the tender in respective items of Schedule-B.

The pipes may be available in approximate size either in metric system, or British system. No additional payment or reduction in payment will be made for such approximate size.

No extra payment for dewatering or installing dewatering sets for pumping out such water shall be made. No extra payment for collar pits shall be made. No extra payment for cutting of pipes, if required shall be made to the Contractor.

In absence of hydraulic/flow test 20% of the amount of the laying and jointing work of pipeline work will be withheld from the running bills till satisfactory hydraulic test is given. If level for invert of pipes in not maintained by the Contractor 100% payment shall be withheld.

**Manufacturing of NP3 and NP4 class R.C.C. Pipes and collars.****1. MATERIALS:**

For precast concrete pipes, materials complying with the requirements given below shall be used.

**(A) CEMENT:**

Cement used for the manufacture of unreinforced and reinforced concrete pipes shall confirm to I.S. 269-1967 or I.S. 455-1989 or I. S. 1489-1967 or 1489-1976 or IS - 8041-1978 or IS - 8043-1978 or IS - 8112-1976.

**(B) AGGREGATES:**

Aggregates used for the manufacture of reinforced concrete pipes shall conform to I.S. 383-1976. The maximum size of aggregate should not exceed one third the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter of 80 to 250 mm the maximum size of aggregate should be 10 mm.

**NOTE:** It is preferable to have the size and grading aggregates conforming to IS-383-1970. It is also preferable that materials finer than 75 micron IS-Sieve are restricted to 3 percent by mass.

**(C) REINFORCEMENT:**

Reinforcement used for the manufacture of the reinforced concrete pipes shall be mild steel grade I or medium tensile steel bars conforming to I.S. 432 (Part-I) 1982 or hard drawn steel wire conforming to I. S. 432 (Part-II) 1982 or structural steel (Standard Quality) bars conforming to IS-226-1975 where soft grade wire is used it shall conform to I.S. 280-1978.

**(D) CONCRETE OR MORTAR:**

Concrete used for manufacture of reinforced concrete pipes and collars shall conform to I.S. 458-2021.

(a) The concrete for non-pressure pipes shall have a minimum cement concrete of 360 Kg/Cumt. and a minimum compressive strength of 20 N/Sq.mm. at 28 days. If mortar is used it shall have a minimum cement content of 450 Kg/Cu.mt. and a compressive strength not less than 20 N/Sq.mm. at 28 days. The concrete for pressure pipes shall a minimum content of 450 Kg/Cu.mt. and a minimum compressive strength of 25 N/Sq.mm. at 28 days. If mortar is used, it shall have a minimum cement of 600 Kg/Cu.mt. and a compressive strength not less than 25 N/Sq.mm. at 28 days.

Where the process of manufacture is such that the strength the concrete or mortar in the pipe differs from that given by test on cubes the two may be related by a suitable conversion factor. If the purchaser required evidence of this factor, he shall ask for it before placing the order. The conversion factor for 28 days compressive strength for spun concrete may be taken at 1.25 in the absence of any data.

Compressive strength tests shall be conducted on 15 cm cubes in accordance with the relevant requirements of I.S. 456-2000 and I.S. 516-1959. if so required by the purchaser the manufacturer shall give a certificate indicating the quantity of cement in the concrete mix.

**DESIGN****REINFORCEMENT:**

The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe and shall be so designed that it may be readily placed and maintained to designed shape and in the proper position within the pipe mould during the manufacturing process. The circumferential and longitudinal reinforcement shall be adequate to satisfy the requirement specified in table 2.

For non-welded lages spiral reinforcement of the same diameter shall be closely spaced at the end of the pipe for a length of 150 mm to minimize damage during handling. The spring of such end spirals shall not exceed 50 mm or half the pitch whichever is less than such spiral reinforcement at ends shall be part of the total spirals reinforcement specified in different table.

The pitch of the circumferential reinforcement shall be not more than the following:

- (a) 200 mm for pipes of nominal internal diameter 80 to 150 mm.
- (b) 150 mm for pipes of nominal internal diameter 200 to 350 mm.
- (c) 100 mm for pipes of nominal internal diameter 400 and above.

The pitch shall also be not less than the maximum size of aggregate plus the diameter of reinforcement bar used.

If so required by the purchaser, the manufacturer shall give a certificate indicating the details relating to quality quantity and dispersion of steel in the pipe as well as the clear cover to the steel provided in the pipe.

**ENDS OF PIPES:** - The ends of concrete pipes shall be suitable for butt and joints for all classes of pipe. Dimensions of collars shall be according the details given in table-2 the reinforcement for the collars shall be as given in table-2. The end of the collar reinforcement shall have a full ring at both ends and the longitudinal reinforcement shall be proportional to the length of the collar.

TABLE – 1 : Attached Separately

TABLE – 2 : Attached Separately

**COVER:** The minimum clear cover for reinforcement in pipe and collars shall be as given below.

**Barrel thickness Minimum clear cover.**

- 
- (1) Up to and including 25 mm 6
  - (2) Over 25 mm and up to & including 30 mm 8
  - (3) Over 30 mm and up to & including 75 mm 10
  - (4) Over 75 mm 15
  - (5) At the end of longitudinal 5

### **3. MANUFACTURE:**

#### **(A) GENERAL**

The methods of manufacture shall be such that the form and the dimensions of the finished pipe are accurate within the limit specified in Indian Standard No.458. The surface and edges of the pipes shall be well defined and true and their ends shall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforced to avoid breakage during transportation.

#### **(B) CONCRETE MIXING:**

Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass in uniform in colour and consistency, but in no case shall the mixing be done for less than two minutes.

The concrete shall be placed before setting has commenced. It shall be ensured that the concrete is not dropped freely so as to cause segregation. The concrete shall be consolidated by spinning, vibrating, spinning combined with vibrations, or other appropriate mechanical means.

#### **(C) REINFORCEMENT CAGES:**

Reinforcement cages for pipes shall extend throughout the pipe barrel and shall be wound round normal collapsible frames or drums. The cages shall consist of spiral or rings and straight of a nailed wire cold drawn wire or mild steel rod and may be circular cages shall be placed symmetrically with the thickness of the pipe wall.

The spiral shall end in a complete ring at both the ends of a pipe.

Pipes having barrel thickness 100 mm and above shall have double reinforcement cage and the amount of spiral steel in the outer cage shall be 75 percentage of the mass of spiral steel in the inner cage, while the total conform to requirements specified in the relevant table of this standard.

The mass of longitudinal in the outer cage and inner cage should be the same that is equal to half the total mass of longitudinal specified in the relevant tables.

Diagonal reinforcement may be provided in pipes for which the cages are not welded so as to help in binding the cage securely. It shall however be ensured that the clear cover for any reinforcement is not below the limit specified. The diagonal reinforcement is a process requirement and shall not be counted against longitudinal and spiral reinforcement.

It is preferable that single reinforcement case should be located near the inner surface of the pipe with adequate clear cover.

#### **(D) CURING:**

- (i) Water Curing:

Pipes manufactured in compliance with this standard shall be cured by immersion in water for a period of not less than two weeks in case of pipes made from ordinary Portland cement or 43 grade ordinary Portland cement, pipes may be water cured by immersing in water covering with water saturated material or by a system of perforated pipes, mechanical sprinklers porous hose, or by any other approved method that will keep pipe during the specified curing period. In the case of large pipe projecting partly above water level, the projecting portion shall be kept wet by any suitable means.

(ii) Steam Curing:

Steam curing of concrete pipes may be permitted provided the requirement of pressure and non-pressure steam curing is fulfilled and pipes conform to the requirements of this specification.

**WORKMANSHIP AND FINISH:**

Pipes shall be straight and free from cracks excepting craze cracks. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight in the trench on opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive) and 6 mm in pipes larger than 600 mm diameter.

The outside and inside surface of the pipes shall be smooth, dense and hard and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacture or supplier. For better bends inner surface of the collar may be finished rough.

The pipes shall free from defects resulting from imperfect grading of the aggregate mixing or moulding. Pipes shall be free from load bents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel. Pipes may be repaired, if necessary, because of accidental injury during manufacture or handling and shall be accepted if in the opinion of the Corporation the repairs and mould and appropriately finished and cured and the repaired pipe forms to the requirements of this specification.

Deviation from Straight: The deviation in straight in any pipe throughout its effective length, tested by means of rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters 3 mm for every meter run.

**TESTING:**

All pipes for testing purpose shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under this standard.

At production of each lot of pipe of each diameter the testing shall be done for each lot of pipes as per I.S. 3597-1998 & 458-2021.

(A) The number of test specimens shall be taken as per table No.1 The following test shall be carried out for each lot.

(1) Three-edge bearing test or load test.

**1.1.3 Procedure :**

(2) Hydrostatic test.

(3) Dimensions.

(4) Workmanship & finish.

(1) **Three edge bearing test or load test:**

Load shall be taken as per table 2

**1.1 Apparatus:**

1.1.1 Testing Machine: - Any mechanical or hand-powered device may be used in which the head that applies the load moves at such a speed as to increase the load at a uniform rate of approximately 200 percent of the expected crushing load per liner metre per minute. The loading device shall be calibrated within an accuracy of + / - 2 percent. The testing machine used for the load tests should produce a uniform deflection throughout the full length of the pipe and shall be so substantial and rigid throughout, that the distribution of the test load

along the length of the barrel of the pipe will not be appreciably affected by the deform or yielding or any part of the machine during the application of the load lower and upper bearing shall be as per I.S. 3597-1998.

1.1.2 The equipment shall be so designed that the load will be distributed about the center of the overall length of all pipe. The load may be applied either at a single point or at multiple points dependent on the length of the pipe being tested and the rigidity of the test frame.

The specimen shall be placed on the two bottom bearing strings in such a manner that the pipe rests firmly and with the most uniform possible bearing on each strip for the full length of the pipes less the socket portion, if any.

If mutually agreed upon by the manufacturer and the Corporation prior to the test, before the pipe is placed, a fillet of plaster of Paris not exceeding 25 mm in thickness may be cost on the surface of the upper and lower bearings. The width of the fillet cap, top or bottom, shall be not more than 25 mm per 300 mm diameter, but in no case less than 25 mm. .LM 10

1.1.3.2 Each end of the pipe at a point mid-way between the lower bearing strips shall be marked and then diametrically opposite points thereof shall be established. The top bearing block shall be so placed that it contracts the two ends of the pipe at these marks. After placing the specimen in the machine on the bottom strips, the top bearing shall be symmetrically aligned in the testing machine. Load shall be applied at the rate indicated in 1.1 until either the formation of a 0.25 mm wide crack or ultimate strength load, as may be specified, has been reached. If both the 0.25 mm crack and ultimate load are required, the specified rate of loading need not be maintained after the load at 0.25 mm crack has been determined.

1.1.3.3 The 0.25 mm crack load is the maximum load applied to the pipe before a crack having a width of 0.25 mm measured at close intervals, occurs throughout a length of 300 mm or more. The crack shall be considered 0.25 mm in width when the point of the measuring gauge penetrates 1.5 mm at close intervals throughout the specified distance of 300 mm. The ultimate load will be reached when the pipe will sustain no greater load.

1.1.3.4 **Calculation:** The crushing strength in Newton per linear metre of pipe shall be calculated by dividing the total load on the specimen by the nominal laying length.

iii **1.1.3 Procedure :**

iv

(2) Hydrostatic test.

(3) Dimensions.

(4) Workmanship & finish.

(1) **Three edge bearing test or load test:**

Load shall be taken as per table 2

**1.1 Apparatus:**

1.1.1 Testing Machine: - Any mechanical or hand-powered device may be used in which the head that applies the load moves at such a speed as to increase the load at a uniform rate of approximately 200 percent of the expected crushing load per liner metre per minute. The loading device shall be calibrated within an accuracy of + / - 2 percent. The testing machine used for the load tests should produce a uniform deflection throughout the full length of the pipe and shall be so substantial and rigid throughout, that the distribution of the test load along the length of the barrel of the pipe will not be appreciably affected by the deform or yielding or any part of the machine during the application of the load lower and upper bearing shall be as per I.S. 3597-1998.

1.1.2 The equipment shall be so designed that the load will be distributed about the center of the overall length of all pipe. The load may be applied either at a single point or at multiple points dependent on the length of the pipe being tested and the rigidity of the test frame.

The specimen shall be placed on the two bottom bearing strings in such a manner that the pipe rests firmly and with the most uniform possible bearing on each strip for the full length of the pipes less the socket portion, if any.

If mutually agreed upon by the manufacturer and the Corporation prior to the test, before the pipe is placed, a fillet of plaster of Paris not exceeding 25 mm in thickness may be cast on the surface of the upper and lower bearings. The width of the fillet cap, top or bottom, shall be not more than 25 mm per 300 mm diameter, but in no case less than 25 mm. .LM 10

1.1.3.2 Each end of the pipe at a point mid-way between the lower bearing strips shall be marked and then diametrically opposite points thereof shall be established. The top bearing block shall be so placed that it contracts the two ends of the pipe at these marks. After placing the specimen in the machine on the bottom strips, the top bearing shall be symmetrically aligned in the testing machine. Load shall be applied at the rate indicated in 1.1 until either the formation of a 0.25 mm wide crack or ultimate strength load, as may be specified, has been reached. If both the 0.25 mm crack and ultimate load are required, the specified rate of loading need not be maintained after the load at 0.25 mm crack has been determined.

1.1.3.3 The 0.25 mm crack load is the maximum load applied to the pipe before a crack having a width of 0.25 mm measured at close intervals, occurs throughout a length of 300 mm or more. The crack shall be considered 0.25 mm in width when the point of the measuring gauge penetrates 1.5 mm at close intervals throughout the specified distance of 300 mm. The ultimate load will be reached when the pipe will sustain no greater load.

1.1.3.4 **Calculation:** The crushing strength in Newton per linear metre of pipe shall be calculated by dividing the total load on the specimen by the nominal laying length.

NOTE: - In most machines the total load will include the dead weight of the top bearing plus the load applied by the loading apparatus.

## 2. HYDROSTATIC TEST:

2.1 **Test Specimen:** The specimens for determination of leakage under internal hydrostatic pressure shall be sound surface dry and full-size pipe.

### 2.2 Procedure:

2.2.1 The pipe shall be supported in such a way so that the longitudinal axis is approximately horizontal and the exterior surface excepting the supports can be examined readily.

2.2.2 The equipment for making the test shall be such that the specimen under test can be filled with water to the exclusion of air and subjected to the required hydrostatic pressure. Apply hydrostatic pressure to the whole pipe including the portion of socket and rebated joints that is subjected to pressure in the "as laid" condition.

2.2.3 The specimen shall be filled with water and the air expelled. Pressure shall be applied gradually the inside of the pipe until the specified test pressure is reached. The test pressure shall be maintained for 2.5 seconds per millimeter thickness of the pipe.

2.2.4 The specimen under test shall show no signs of leakage either in the barrel or socket. Moisture appearing on the surface of the specimen in the form of patches shall not be considered as leakage. If during the test, beads of water appear on the specimen for an additional period equal to the initial period required for the test and the specimen shall be accepted if the beads do not grow on run.

2.3 The NP3 and NP4 class R.C.C. Pipes shall be capable of withstanding a test pressure of 0.7 Kg/Sq.cm. (7.0 m head)

## 3. DIMENSIONS:

3.1 Pipes :- The internal diameter, wall thickness and length of barrel and collar of pipes, the minimum reinforcements and strength test requirements for the six classes of pipe shall be as specified in Table-2. For collar jointed pipes, effective length shall be 2 mt or 2.50 mt. up to 250 mm nominal diameter pipes and 2.5, 3.0, 3.5 or 4.0 mt. for pipes above 250 mm nominal diameter.

3.2 **Tolerances:** - The following tolerances shall be permitted:

Dimensions	Tolerances
(A) Overall length	: +/- 1 percent of standard length.
(B) Internal diameter of pipes or socket	
1) Up to and including 300 mm	: +/-3 mm

2) Over 300 mm and up to and including 600 mm.	:	+/- 5
3) Over 600 mm and up to and including 1200 mm.	:	+/- 7 mm including 1200 mm.
4) Over 1200 mm	:	+/- 10 mm
(C) Barrel wall thickness		
1) Up to and including 30 mm	:	+ 2 mm - 1 mm
2) Over 30 mm and up to and including 50 mm.	:	- 1.5 mm + 3 mm
3) Over 50 mm and up to and including 65 mm.	:	+ 4 mm - 2.5 mm
4) Over 65 mm and up to and including 80 mm.	:	+ 6 mm - 3 mm
5) Over 80 mm and up to and including 95 mm.	:	+ 6 mm - 3 mm
6) Over 95 mm	:	+ 7 mm - 3.m mm

#### (4) SAMPLING AND INSPECTION:

(A) LOT : In any consignment, all the pipes of same class, same size and belonging to the same mix of concrete shall be grouped together to constitute a lot for ascertaining the conformity of material to the requirements of this specification, samples shall be tested for each lot separately.

The No. of pipes to be selected from the lot shall depend on size of the lot and shall be according to the table below.

#### SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of pipes in lot	FOR REQUIREMENTS UNDER 3 & 4		SAMPLE SIZE FOR TEST EXCLUDING ULTIMATE LOAD TEST
	Sample size	Permissible Number of defectives	
Up to 50	8	0	2
51 to 100	13	1	3
101 to 300	20	2	5
301 to 500	32	3	7
500 and above	50	5	10

#### (B) NUMBER OF TESTS AND CRITERIA FOR CONFORMITY:

(i) All the pipes selected according to above table shall be inspected for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.

ii The lot shall be declared as conforming to these requirements if the number of defectives found in the sample does not exceed the number of defectives given in Col.3

(iii) The lot having found satisfactory shall be further subjected to the tests except ultimate load test for this purpose, the number of pipes given in Col.4 of above table shall be selected from the lot.

#### (5) MARKING:

The following information be clearly marked on each pipe.

(a) Class of pipe.

(b) Date of manufacture and

(c) Name of manufacturer or his registered trade mark or both.

(d) Dia of pipe.

The above information shall be clearly marked on outside only for pipes up to 350 mm and including 350 mm internal diameter and both outside and inside for pipes above 350 mm internal diameter.

### Design and strength test requirements of concrete pipes of class NP3.

Reinforced concrete - Medium duty Non-pressure pipes.

Nominal Internal Diameter of pipes	Barrel wall thickness	Reinforcement			Strength test requirements for three edge bear test	
		Longitudinal mild steel or hard drawn steel		Spiral hard drawn Kg./ Linear meter	Load to produce 0.25 mm crack Kn/Linear	Ultimate load Kn/Linear meters
		Minimum	Kg/Linear meter			
1.	2.	3.	4.	5.	6.	7.
80	25	6	0.59	0.17	13.00	19.50
100	25	6	0.59	0.24	13.00	19.50
150	25	6	0.59	0.49	13.70	20.55
200	30	6	0.59	0.68	14.50	21.75
225	30	6	0.59	0.86	14.80	22.20
250	30	6	0.59	1.05	15.00	22.50
300	40	8	0.78	1.53	15.50	23.25
350	75	8	0.78	1.58	16.77	25.16
400	75	8	0.78	1.60	19.16	28.74
450	75	8	0.78	1.90	21.56	32.34
500	75	8	0.78	1.97	23.95	35.93
600	85	8 or 6 + 6	1.18	2.82	28.74	43.11
700	85	8 or 6 + 6	1.18	4.87	33.53	50.30
800	95	8 or 6 + 6	2.66	6.87	38.32	57.48
900	100	6 + 6	2.66	11.55	43.11	64.67
1000	115	6 + 6	2.66	15.70	47.90	71.85
1100	115	6 + 6	2.66	20.42	52.69	79.00
1200	120	8 + 8	3.55	24.74	57.48	86.22
1400	135	8 + 8	3.55	46.21	67.06	100.60
1600	140	8 + 8	3.55	65.40	76.64	114.96
1800	150	12 + 12	9.36	87.10	86.22	129.33
2000	170	12 + 12	9.36	97.90	95.80	143.70
2200	185	12 + 12	9.36	133.30	105.38	158.07
2400	200	12 + 12	14.88	146.61	114.96	172.44
2600	215	12 + 12	14.88	175.76	124.54	186.81

NOTE: 1 : The actual internal diameter is to be declared by the manufacturer and the tolerance is to be applied on the declared diameter.

NOTE: 2 : The longitudinal reinforcement given in this table is valid for pipes up to 2.5 mt effective length for internal diameter of pipe up to 250 mm and upto 3 mt. effective length for higher diameter pipes.

NOTE :3: Concrete for pipes above 1800 mm nominal diameter shall have a minimum compressive strength of 35 N/Sq.mm. at 28 days.

NOTE: 4 : If mild steel is used for spiral reinforcement, the weight specified in col.5 shall be measured to 140/125.

NOTE: 5 : Total mass of longitudinal reinforcement shall be calculated by multiplying the value given in Col. By the length of pipe and then deducting for the cover length provided at the two ends.

#### Design and strength test requirements of concrete pipes of class NP4.

Reinforced concrete - Heavy duty Non-pressure pipes.

Nominal Internal Diameter of pipes	Barrel wall thickness	Reinforcement			Strength test requirements for three edge bear test	
		Longitudinal mild steel or hard drawn steel		Spiral hard drawn Kg. / Linear meter	Load to produce 0.25 mm crack KN/Linear	Ultimate load KN/Linear meters
		Minimum	Kg/Linear meter			
1.	2.	3.	4.	5.	6.	7.
80	25	6	0.59	0.26	22.10	33.15
100	25	6	0.59	0.37	22.10	33.15
150	25	6	0.59	0.76	23.30	34.95
200	30	6	0.59	0.88	24.60	36.90
225	30	6	0.59	1.11	25.20	37.80
250	30	6	0.59	1.35	25.50	38.25
300	40	8	0.78	1.53	26.40	39.60
350	75	8	0.78	1.61	29.80	44.70
400	75	8	0.78	1.97	33.90	50.90
450	75	8	0.78	3.36	36.90	55.30
500	75	8	0.78	5.56	40.00	61.20
600	85	8 or 6 + 6	2.34	8.50	46.30	69.40
700	85	8 or 6 + 6	3.44	12.78	52.20	78.30
800	95	8 or 6 + 6	3.44	16.72	59.30	89.10
900	100	6 + 6	3.44	20.92	66.30	99.40
1000	115	8 + 8	6.04	26.70	72.60	108.90
1100	115	8 + 8	6.04	38.02	80.40	120.60
1200	120	8 + 8	6.04	46.25	88.30	132.40
1400	135	8 + 8	9.36	59.20	99.10	148.65
1600	140	12 + 12	9.36	86.60	109.90	164.85
1800	150	12 + 12	14.88	103.30	120.70	181.05
2000	170	12 + 12	14.88	125.28	131.50	197.25
2200	185	12 + 12	14.88	154.94	142.20	213.30
2400	200	12 + 12	14.88	181.25	155.00	232.50
2600	215	12 + 12	14.88	208.25	166.70	250.00

NOTE: 1 : The actual internal diameter is to be declared by the manufacturer and the tolerance is to be applied on the declared diameter.

NOTE: 2 : The longitudinal reinforcement given in this table is valid for pipes up to 2.5 mt effective length for internal diameter of pipe up to 250 mm and upto 3 mt. Effective length for higher diameter pipes.

NOTE :3: Concrete for pipes above 1800 mm nominal diameter shall have a minimum compressive strength of 35 N/Sq.mm. At 28 days.

NOTE: 4 : If mild steel is used for spiral reinforcement, the weight specified in col.5 shall be measured to 140/125.

NOTE: 5 : Total mass of longitudinal reinforcement shall be calculated by multiplying the value given in Col. By the length of pipe and then deducting for the cover length provided at the two ends.

#### DESIGN REQUIREMENTS OF REINFORCED CONCRETE COLLARS FOR PIPES OF NP3 AND NP4 CLASS

Nominal Internal Diameter of pipes	COLLAR DIMENSIONS			REINFORCEMENTS		
	Minimum caulking space	Minimum thickness	Minimum Length	Longitudi nal or hard drawn Minimum Nos.	Mild steel weight Kg/ collar	Spiral hard drawn steel Kg/ Collar
1.	2.	3.	4.	5.	6.	7
80	13	25	150	6	0.08	0.07
100	13	25	150	6	0.08	0.08
150	13	25	150	6	0.08	0.10
200	13	25	150	6	0.08	0.12
225	13	25	150	6	0.08	0.14
250	13	25	150	6	0.08	0.16
300	16	30	150	8	0.11	0.22
350	19	32	200	8	0.15	0.40
400	19	32	200	8	0.15	0.50
450	19	35	200	8	0.15	0.60
500	19	35	200	8	0.15	0.70
600	19	40	200	8	0.23	1.05
700	19	40	200	8	0.23	1.85
800	19	50	200	8	0.23	2.05
900	19	50	200	8	0.33	2.25
1000	19	55	200	8	0.33	3.09
1100	19	65	200	8	0.33	4.11
1200	19	75	200	12	0.50	5.08
1400	19	80	200	12 or 8 + 8	0.67	6.55
1600	19	90	200	12 or 8 + 8	0.67	9.00
1800	19	100	200	12+12	1.00	12.15
2000	19	110	200	12+12	1.00	13.30

NOTE: 1 : Collars for sizes 2200 mm and above shall be made out of mild steel plate of 6 mm thickness, steel conforming to IS:226-1975 with outside painted.

NOTE: 2 : If mild steel is used for spiral reinforcement, the weight specified in Co.7 shall be increased by factor 140/125.

NOTE: 3 : Soft grade mild steel wire for spirals may be used for collars of pipes of internal diameter up to 150 mm only by increasing weight by a factor 140/84.

**DESIGN AND STRENGTH TEST REQUIREMENTS OF PIPES OF CLASS NP2  
REINFORCED CONCRETE LIGHT-DUTY, NON-PRESSURE PIPES.**

Internal Diameter of pipe	Barrel Dimension		Collar Dimension			Longitudinal mild steel at permissible stress of 1.265 Kg/SQ.Ca.	Spiral		Strength test requirement			
	Length	Minimum thickness	Minimum caulking	Minimum thickness	Minimum length		A Hard drawn steel wire at permitted stress of 1400 Kg/Sq.cm	Soft grad mild steel wire permitted stress of 840 Kg/Sq.cm	Load to produce 0.25 mm crack	ultimate load	Load to produce 0.25 mm crack (Sand bearing test)	Ultimate load
1	2	3	4	5	6	7	8	9	10	11	12	13
mm	mm	mm	mm	mm	mm	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m	Kg/ Liner m
80	2.0	25	13	25	150	0.863	0.083	0.138	1.040	1.560	1.560	2.340
100	2.0	25	13	25	150	0.863	0.166	0.277	1.040	1.560	1.560	2.340
150	2.0	25	13	25	150	0.86.	0.219	0.365	1.040	1.560	1.560	2.340
200	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
225	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
250	2.0	25	13	25	150	0.863	0.710	-	1.040	1.710	1.560	2.565
300	2.0 or 2.5 or 3.0	30	16	30	150	1.00	1.295	-	1.200	1.800	1.800	2.700
350	2.0 or 2.5 or 3.0	32	16	32	150	1.00	1.750	-	1.200	1.800	1.800	2.700
400	2.0 or 2.5 or 3.0	32	16	32	150	1.00	2.250	-	1.360	1.040	2.040	3.060
450	2.0 or 2.5 or 3.0	35	19	35	200	1.00	2.750	-	1.480	2.220	2.220	3.330
500	2.5 or 3.0	35	19	35	200	1.25	3.220	-	1.660	2.490	2.490	3.735
600	2.5 or 3.0	40	19	40	200	1.25	4.90	-	1.900	2.850	2.850	4.275
700	2.5 or 3.0	40	19	40	200	1.78	6.05	-	2.100	3.150	3.150	4.725
800	2.5 or 3.0	45	19	45	200	1.78	9.10	-	2.300	3.450	3.450	5.170
900	2.5 or 3.0	50	19	50	200	1.78	11.35	-	2.500	3.750	3.750	4.625
1000	2.5 or 3.0	55	19	55	200	2.50	13.50	-	2.650	4.020	4.020	6.030

1200	2.5 or 3.0	65	19	65	200	2.50	18.20	-	2.880	4.320	7.320	6.480
1400	2.5 or 3.0	75	19	75	200	3.36	22.60	-	2.980	4.470	4.70	6.705
1600	2.5 or 3.0	80	19	80	200	3.36	28.30	-	2.980	4.470	4.470	6.705
1800	2.5 or 3.0	92	19	90	200	3.36	36.00	-	2.980	4.470	4.470	6.70

NOTE:- If steel wires are used as longitudinal reinforcement, the weight specified in Column 7 shall be modified by a factor 1 265/1 400.

NOTE:- If mild steel is used for spiral reinforcement, the weight specified under Column 8 shall be increased to 1 400/1 265.

NOTE:- Use of soft grade mild steel wire for spiral reinforcement is not recommended for pipes of internal diameter larger than 150 mm.

### **TERMS AND CONDITIONS OF CONTRACT FOR SUPPLYING NP3 AND NP4 CLASS SPIGOT SOCKET FLUSH TYPE RUBBER RING JOINTS R.C.C. PIPES AND SPECIALS**

1. The pipes and special mentioned in Schedule 'B' attached herewith shall be delivered on site as shown by the Executive Engineer, South Zone A (Udhana) or stacked in the Company's premises till required by the Executive Engineer, South Zone A (Udhana).
2. The rates per meter for the supply of pipes of different categories shall include the cost of necessary collars requires to be supplied along with each pipe length and specials. The collars shall be machine moulded. Hand moulded collars shall not be accepted.
3. The company will have to make their own arrangement for procuring steel and wire etc. required for the said works. The company shall neither claim any rise in rates due to any causes whatever for the supply of pipes and specials mentioned in schedule under Para (1) Nor shall the Municipal Corporation claim and reduction in rates for the same due to any causes whatsoever.
4. The pipes etc. shall manufactured to the I.S. specification 458- 2021 with the latest amendments of 1991.
5. At production of each lot of pipe of each size, the Contractor shall send the letter of offer for testing of pipes of Executive Engineer, South Zone A (Udhana). The authorized representative of Executive Engineer, South Zone A (Udhana) shall test the pipes as per I.S. 3597-1998 & I.S. 458-2021 with latest amendments.
6. The Contractor shall use the reinforcement as specified in I.S. 458-2021 with latest amendment. 2% of the pipes may be broken to ascertain the weight of steel and if not found in accordance with I.S. Specification the whole lot shall be rejected or the payment shall be made at the reduced rate as settled by the Commissioner, S.M.C. The cost on the pipe broken for inspection shall be born by the Contractor in any case.
7. The successful tenderer shall deposit a sum equal to 2% of the tendered amount with the Surat Municipal Corporation for due fulfillment of various terms and conditions of contract and the same shall be returned to the company on presentation of certificate from the Executive Engineer, South Zone A (Udhana) that the terms and conditions of the contract has been fulfilled.
8. If the company do not abide by any of the terms of the agreement, the Municipal Corporation will have the right to cancel the contract by giving 15 days' notice and the amount of 2% of Security Deposit shall be forfeited to the Municipal Corporation for the breach of the contract. The company shall further be liable to pay extra cost that right be

incurred by the Municipal Corporation for the purchase of pipe and specials from any other source.

9. The Municipal Corporation is at liberty to curtail the quantity of pipes of each category as per the requirements.

10. The pipes shall have to be supplied within the time as shown in Memorandum (Failing which the Municipal Corporation shall be at liberty to penalty clause. The time limit shown in memorandum status from the date of placing order.

**TABLE-14: SPIGOT AND SOCKET DIMENSIONS OF NP2 AND NP3 CLASS PIPES (RUBBER RING ..... ON JOINT) FROM 80 TO 900 MM DIAMETER**

Pip e dia.	Ru bb er rin g ch art dia	Rub ber ring int. dia.	T	RS	D S	D S1	D S2	D S3	R	LS D	K	N	LT	HT	LS P	P	S	H	X	W	RI
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	230	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
225	11	255	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
250	11	275	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
300	12	340	40	51	90	12	42	36	6	7	7	130	130	53	55	7.5	6	34	1	1	6
350	16	435	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
400	16	480	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
450	16	575	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
500	16	570	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
600	20	625	85	85	150	20	70	60	10	12	12	193	153	88.5	90	12	10	75	2	2	10
700	20	765	85	85	150	20	70	60	10	12	12	193	153	88.5	90	12	10	75	2	2	10
800	20	875	95	95	150	20	70	60	10	12	12	197	171	98.5	90	12	10	85	2	2	10
900	20	970	100	100	150	20	70	60	10	12	12	200	180	103.5	90	12	10	90	2	2	10
900	20	970	100	100	150	20	70	60	10	12	12	200	180	103.5	90	12	10	90	2	2	10

ALL DIMENSIONS IN MILLIMETERS

NOTE:-

1. Corners to be rounded off.

2. The dimensions DS2, DS3, LSP, IS, T, H, S, HT and K shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerance shall supply on the critical dimensions.

### Dimensions Tolerances

**T and GT same as that of barrel wall thickness given in 8.2**

**TS and H half the tolerance on barrel wall thickness given in 8.2**

**DS2, DS3, K & S The tolerance, in mm shall be as given below:**

Chart Diameter	DS2	DS3	LSP	K	S
10	12	+/-3	+/-4	+/-1.25	+/-0.75
12	12	+/-3	+/-4	+/-1.25	+/-0.75
16	12.5	+/-3	+/-4	+/-2.00	+/-1.25
20	13	+/-3	+/-4	+/-2.25	+/-1.55

**TABLE-17: SPIGOT AND SOCKET DIMENSIONS OF NP3 / NP4 CLASS PIPES FROM 1000 TO 2600 MM DIAMETER**

(RUBBER RING CONFINED JOINT)

ALL DIMENSIONS IN MILIMETRES

Pipe Diameter	Rubber ring chart diameter	Rubber ring internal diameter	T	TS	LS	LSI	K	LSP	a	b	j	H	i	l	iD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1100	20	920	115	58.0	114	20	13	114	25	28	39	42	4	9	1100
1100	20	1009	115	58.0	114	20	13	114	25	28	39	42	4	9	1202
1200	20	1095	120	60.5	114	20	13	114	25	28	39	44.5	4	9	1307
1400	25	1275	135	67.5	114	20	16	114	25	35	42.5	50	4	10	1520
1600	25	1445	140	72.5	114	25	16	114	25	35	42.5	50	4	10	1720
1800	25	1620	150	77.5	114	25	16	114	25	35	42.5	55	4	10	1930
2000	25	1810	170	87.5	114	25	16	114	25	35	42.5	65	4	10	2150
2200	25	1995	185	95.0	114	25	16	114	25	35	42.5	72.5	4	10	2365
2400	25	2180	200	102.5	114	25	16	114	25	35	42.5	87.5	4	10	2580
2600	25	2360	215	110.0	114	25	16	114	25	35	42.5	87.5	4	10	2995

### NOTES:

1. Corners to be rounded off.

2. The dimensions LS, LSP, TS, T, H, L, b and K shall conform to the values given in this table as these are critical dimensions. Outer dimensions are for guidance only. The following tolerance shall apply on the critical dimensions.

Dimensions Tolerances

LS and LSP +7 mm

T Same as that of barrel wall thickness given in 8.2

H and TS Half the tolerance on barrel wall thickness given in 8.2

L +0.5 MM

b +1 mm for 28 mm and +1.5 mm for 35 mm

K +1.75 mm for 20 mm rubber ring chord dimensions

+2.5 mm for 25 mm rubber ring chord dimensions

**TABLE-20 WEIGHT OF SPIRALS (HARD DRAWN STEEL) IN SOCKET OF R/R JOINT**

R.C.C. PIPES OF DIFFERENT CLASSES (Kg./Number)

Internal diameters of pipes	NP2 Class	NP3 Class	NP4 Class	P1 Class	P2 Class	P3 Class
1.	2.	3.	4.	5.	6.	7.
80	0.08	0.08	0.08	0.08	0.08	0.08
100	0.09	0.09	0.09	0.09	0.09	0.09
150	0.12	0.12	0.12	0.12	0.12	0.15
200	0.14	0.14	0.21	0.14	0.21	0.35
225	0.15	0.15	0.26	0.15	0.26	0.43
250	0.16	0.16	0.31	0.16	0.31	0.51
300	0.45	0.45	0.53	0.45	0.53	0.84
350	0.51	0.64	0.64	0.51	0.74	1.24
400	0.56	0.71	0.71	0.56	0.99	1.66
450	0.63	0.76	0.76	0.63	1.23	2.26
500	0.68	0.87	1.08	0.68	1.57	2.85
600	0.81	1.00	2.12	1.52	2.88	4.74
700	0.92	2.16	3.02	1.79	3.96	6.79
800	1.14	2.87	4.67	2.04	6.28	9.99
900	1.50	4.06	6.03	2.63	8.29	-
1000	1.91	-	-	3.33	1.29	-
1100	2.34	-	-	4.08	-	-
1200	2.84	-	-	4.90	-	-
1400	3.82	-	-	-	-	-
1600	5.64	-	-	-	-	-
1800	7.25	-	-	-	-	-
2000	11.78	-	-	-	-	-
2200	12.88	-	-	-	-	-

**NOTES:**

1. Longitudinal reinforcement shall be proportional to be the length of socket cage as given in Tables 2 to 11.
2. If mild steel is used for spiral reinforcement, the weight specified above shall be increased to 140/125.

**SPECIFICATION FOR RUBBER RINGS FOR SEWERS: INDIAN STANDARD: 5382-1985**

**1. SCOPE:**

1.1 This standard prescribes the requirements for materials used for vulcanized solid rubber sealing rings for water supply and drainage system, drain pipes, sewers and rainwater pipes, all at ambient temperature including gas connections. It covers joint rings for all pipe line

materials including iron, steel, stoneware, asbestos cement concrete, pitch fiber, plastics and glass reinforced plastics.

## 2. TYPES:

2.1 This standard covers six types of pipe joint rings, namely, 1 to 6. These correspond to the respective nominal hardness of 40, 50, 60, 70, 80 and 88 IRHD.

2.2 Sealing rings having two different types of rubber are permitted.

## 3. REQUIREMENTS.

3.1 Material: The rubber shall be free from extractable substances which impart taste, odour of toxicity of water.

3.2 The rings shall be homogeneous, free from porosity, grit, excessive blooms, blisters or other visible surface imperfections.

3.3 Stretch Test: Stretch gaskets till the circumference is increased by 50 percent, then visually inspect for the following.

3.3.1 Gaskets shall be made of a properly vulcanized virgin rubber compound containing no scrap or reclaim.

3.2.2 The surface of the gasket shall be smooth free from pitting cracks, blisters, air marks, and any other imperfection that may affect its behavior in service. The body of the gasket shall be free from porosity and air pockets.

3.4 Unless otherwise specified, the materials shall be black.

3.5 Dimensions and Tolerances - All the dimensions and tolerances shall be as agreed to between the purchaser and the manufacturer/supplier.

### 3.6 Physical Requirements:

3.6.1 Hardness: Hardness when determined in accordance with Micro test method described in IS: 3400 (Part-I)-1980 (Methods of test for vulcanized rubber: Part-2 Hardness.). Hardness when determined in accordance with micro test method described in IS-3400 (Part-II) 1980 shall comply with the requirements given in Table-1. If the Dimensions of the ring are appropriate than 'Normal Test Method' specified in IS3400 (Part-II) 1980 may be used provided that the 'Micro Test Method' is used for reference purpose.

3.6.2 Tensile Strength and Elongation at Break: Determined by the method described in IS:3400 (Part-1)-1977 [Methods of test for vulcanized rubber : Part-1 Tensile stress-strain properties (first revision)].

3.6.3 Compression Set: Determined by the method described in IS: 3400 (Part-10)-1977. [Methods of test for vulcanized rubber: Part-10 Compression set at constant strain (first revision)]

3.6.4 Accelerated Ageing in Air: By the oven method described in IS-3400 (Part-4)-1983, the changes in hardness, tensile strength and elongation at break after ageing shall comply.

3.6.5 Water Immersion: Determined according to the method given in IS-3400(Part-6)-1983 after 7 days immersion in neutral water pH 7 at 70°C.

3.6.6 Cold Resistance: When cooled in a chamber described in Appendix-B (IS-5382-1985), the increase in hardness, measured after 7 days at - 10°C, from the initial hardness, shall comply with the requirements given in as per IS.

3.6.7 Water Absorption: Sealing rings shall not absorb more than 10 percent (m/m) of water when tested according to the method prescribed in relevant IS.

## 4. MARKING:

4.1 Each sealing ring or packing or both shall be marked indelibly with:

(a) The manufacturer's name or trade-mark, if any;

(b) The month and year of manufacture; and

(c) The type following by a word, such a 'Gas' or 'Water' or 'Sewers' depending on the application for which they are intended.

4.1.1 Each sealing ring or packing or both may also be marked with the Standard Mark.

Note: The use of the standard mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and regulations made there under. The Standard Mark on

products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing, and quality control which is devised and supervised by BIS and operated by BIS for conformity to that standard as a further safeguard. Details of conditions under which a license for the use of the Standard Mark may be obtained from the Bureau of Indian Standards.

#### 5. PACKING:

5.1 The material shall be packed as agreed to between the purchaser and the supplier so as to protect them from undue exposure to light and heat and mechanical damages during transit and storage.

#### 6. SAMPLING:

6.1 Scale of Sampling and Criteria for Conformity: For the purpose of ascertaining conformity to this standard the scale of sampling and criteria for conformity shall be as prescribed as per relevant I.S.

#### 7. TIME LAPSE BETWEEN RECEIPT OF MATERIAL AND TESTING:

7.1 For all the test purposes, the minimum time between vulcanization and testing shall be 16 h.

7.1.1 For product tests, whenever possible, the time between vulcanization and testing should not exceed 4 months. In other cases, tests shall be made within 2 months from the date of receipt of the product by the customer.

#### 8. TEST PIECE:

8.1 Wherever possible, for all tests, test pieces shall be cut from the finished article. Where this is not possible, the manufacturer shall provide test slabs from the same batch of rubber and vulcanized to the same degree and in the same manner as that of the rubber from which the sealing rings have been manufactured.

8.1.1 Wherever it is not possible to cut standard test piece from the rings, for determination of tensile strength and elongation at break, test piece as shown in drawing shall be used with the rate of traverse of moving grip as 15 cm/min.

#### APPENDIX-C

(Clause 3.7.8)

#### WATER ABSORPTION

##### C.1 PROCEDURE:

C.1.1 From the finished ring cut a piece of about 3 g. Weigh it accurately. Put in 150 ml of distilled water. Boil under reflux with air condenser for 168 hours. Remove the piece and weigh again after surface water layer is dried up.

##### C.2 CALCULATION:

C.2.1 Calculate the water absorption as follows:

$$M_2 - M_1$$

$$\text{Water absorption, percent by mass} = \frac{\text{-----}}{M_1} \times 100$$

Where

M<sub>1</sub> = original mass in g of the test piece before immersion in water and

M<sub>2</sub> = mass in g of the test piece after immersion in water.

For prescribed limit see-3.6.7

#### APPENDIX-D

(Clause 6.1)

#### SAMPLING AND CRITERIA FOR CONFORMITY:

##### D.1 SCALE OF SAMPLING:

D.1.1 Lot - In a consignment all the sealing rings of the same type, dimensions, design and manufactured from the same type of rubber under essentially similar conditions of production shall be grouped together to constitute a lot.

D.1.2 Samples shall be selected and tested from each lot separately for ascertaining its conformity or otherwise to the requirements of this specification.

D.1.3 The number of sealing rings to be selected at random from a lot for different tests shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table-3

TABLE-3 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of sealing rings in the lots	For diamensions and finishing defects (see 3.2 and 3.3		No. of tests for each characteristic for hardness, tensile strength, elongation compression test set, water absorption and stretch tests	No. of tests for each characteristic for ageing and water immersion test (Table:1 & 2
	Sample size	Permissible No. of defective		
Upto 100	5	0		
101- 150	8	0	3	1
151 - 300	13	0		
300 - 500	20	0		
501 - 1000	32	1	5	2
1001 and above	50	3	8	3

D.1.3.1 The rings to be selected from the lot shall be chosen at random. In order to ensure the randomness of selection, random number tables shall be followed. In case random number tables are not available, the rings may be selected from the lot in the following manner: Starting from any ring in the lot, the rings shall be counted as 1.2.....r and so on in one order, where r is the integral part of N/n (N and n being the lot size and sample size respectively). Every rah ring thus counted shall be withdrawn to constitute the sample.

D.1.3.2 If the rings are packed in bundles, at least 10 percent of the bundles shall be opened and the required number of rings shall be selected by taking approximately equal number of rings at random from each of the bundle.

## D.2 NUMBER OF TEST AND CRITERIA AND CONFORMITY:

D.2.1 All the sealing rings selected according to D.1.3 shall be examined for dimensions and finishing defects. Any ring failing in one or more of these characteristics shall be considered as defective. If the number of defectives found in the sample is less than or equal to the corresponding permissible number given in col-3 of Table-3, the lot shall be declared as conforming to these requirements, otherwise not.

D.2.1.1 In the case of those lots when have been found unsatisfactory according to D.2.1 all the sealing ring may depending upon the agreement between the purchaser and the supplier, be inspected for these characteristics and the defective ones removed.

D.2.2 The lot having been found satisfactory for workmanship and dimensions according to D.2.1 shall then be examined for hardness, tensile strength, elongation strength, swelling, water absorption and compression characteristics. The number of tests to be conducted for such of these characteristics is given in col-4 of Table-3. For this purchase, required number of rings shall be selected at random from those already selected under D.1.3 and if necessary, from the lot. For each of the characteristics the various tests shall be conducted on independent test pieces. The lot shall be declared as satisfactory if the medium value of the test results of compression characteristic satisfies the relevant requirements and for the remaining characteristics none of test fails.

D.2.3 The lot which has been found satisfactory according to D.2.2 shall then be subjected to relevant ageing and oil immersion tests. The number of independent tests to be conducted for each of the characteristics is given in col-5 of Table-3. For this purpose, required number of rings shall be selected from those which have been tested and found satisfactory under D-2.2.

The lot shall be declared satisfactory with respect to ageing characteristic if none of the test fails.

### **Item No: 7.13 Providing & Constructing machinehole**

**7.13 Providing & Constructing machinehole as per type & design with necessary excavation, p.c.c. in 1:4:8, benching in 1:2:4, brick masonry in C.M. 1:4, 12mmth. inside plaster in C.M. 1:3, Prov. & fixing r. c.c. mh. frame & cover in c.c. 1:2:4, & 150mmth. R.C.C. slab in 1:1.5:3 including Prov. fixing polypropylene Steps etc. comp.**

**"A" TYPE machinehole Sewer size : up to 600 mm dia. , Chamber Size : 1200 mm x 1000 mm Shallow machinehole depth up to 2.5 mt. Rate For 2.5 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"B1" TYPE machinehole Sewer size : up to 1000 mm dia., Chamber Size : 1500 mm x 1000 mm Shallow machinehole depth up to 2.5 mt. Rate For 2.5 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"B2" TYPE machinehole Sewer size : up to 1000 mm dia., Chamber Size : 1500 mm x 1000 mm Deep machinehole with access shaft depth 2.5 mt to 4.0 mt Access Shaft Size : 850 mm x 850 mm Rate For 4.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**B3" TYPE machinehole Sewer size : up to 1000 mm dia., Chamber Size : 1500 mm x 1000 mm Deep machinehole with access shaft depth 4.0 mt to 6.0 mt Access Shaft Size : 850 mm x 850 mm Rate For 6.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"C1" TYPE machinehole Sewer size : 1100mm to 1400 mm dia., Chamber Size : 1800 mm x 1000 mm Shallow machinehole depth up to 2.5 mt. Rate For 2.5 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"C2" TYPE machinehole Sewer size : 1100mm to 1400 mm dia., Chamber Size : 2400 mm x 1000 mm Deep machinehole with access shaft depth 2.5 mt to 4.0 mt Access Shaft Size : 850 mm x 850 mm Rate For 4.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**C3" TYPE machinehole Sewer size : 1100 mm to 1400 mm dia., Chamber Size : 2400 mm x 1200 mm Deep machinehole with access shaft depth 4.0 mt to 6.0 mt. Access Shaft Size : 850 mm x 850 mm Rate For 6.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"D1" TYPE machinehole Sewer size : 1600 mm to 1800 mm dia., Chamber Size : 2200 mm x 1000 mm Shallow machinehole depth up to 2.5 mt. Rate For 2.5 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"D2" TYPE machinehole Sewer size : 1600 mm to 1800 mm dia., Chamber Size : 2400 mm x 1200 mm Deep machinehole with access shaft depth 2.5 mt to 4.0 mt Access Shaft Size : 850 mm x 850 mm Rate For 4.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**"D3" TYPE machinehole Sewer size : 1600 mm to 1800 mm dia., Chamber Size : 2400 mm x 1200 mm Deep machinehole with access shaft depth 4.0 mt to 6.0 mt. Access Shaft Size : 850 mm x 850 mm Rate For 6.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

**E" TYPE machinehole Sewer size : 2000 mm to 2200 mm dia., Chamber Size : 3000 mm x 1500 mm Deep machinehole with access shaft depth 4.5 mt to 6.0 mt. Access Shaft Size : 850 mm x 850 mm Rate For 6.0 mt Depth**

**Add. or ded. per every 10 cm increase or decrease in depth**

#### **GENERAL:**

The item pertains to construction of manhole chambers of Fly-ash lime building brick in 1:4 cement mortar, foundation concrete 1:4:8 with coarse aggregates of trap metal of 25 mm to

40 mm size, foundation 250 mm thick, benching in 1:2:4 inside 1:3 cement mortar 12 mm thick plaster with outside flush joint and 150 mm thick R.C.C. 1:1.5:3 over slab of manhole chambers with opening as per design and drawing for fitting R.C.C. Manhole cover.

(i) The size and depth of manhole of all types shall be measured from top of M.H. cover and frame to invert level of drains (as per L-section, drawing and hydraulic design) for purpose of payment (Note: For Box drain depth of M.H. shall be measured from top of the top slab box drain.

(ii) The item and rate also include shoring and strutting without any extra cost.

(iii) The manhole shall be fitted with heavy duty R.C.C. manhole covers, and frame as the case may be and as directed by the Engineer-in-charge.

(iv) The item and rate include providing fixing manhole covers with frame etc. as per the drawing and as directed. For fixing 1:2:4 concrete in trapezoidal shape shall be casted as shown in drawing.

#### **MATERIALS:**

##### **BRICKS:**

Fly ash lime brick shall be used for this item and shall comply with specification of relevant I.S. (latest

version). Sample of Fly ash lime bricks shall be got approved by the Engineer, who will keep it in his

office for reference. Fly ash lime Brick shall conform to M-15A of detail specification of material.

##### **MORTAR:**

Mortar shall conform to latest relevant I.S. versions. The quantity of mortar to be used for one cubic meter of masonry shall vary from 0.24 cubic meter for this masonry to 0.26 cubic meter for massive masonry of conventional Fly ash lime brick and 0.25 cubic meter for thin masonry to 0.27 cubic meter for massive masonry of I.S.I. bricks. The proportion of cement mortar shall be as specified in the item and special provisions of the tender.

##### **POLYPROPYLENE STEPS**

Polypropylene steps of approved design shall be supplied and item is including loading, unloading, carting, etc. for manhole including fixing into C.M. (1:4) etc. complete as per the drawing and as directed by the Engineer-in-charge. Spacing of steps at be 300 mm c/c, but in staggered fashion.

##### **MATERIALS:**

The polypropylene steps shall conform to ASTM D-4101, injection moulded around a 12 mm dia. IS-1786 grade Fe-500 steel bars. It shall be of approved quality and size shall be 300 mm x 150 mm x 25 mm and fixed in wall in staggered position as per instruction of the Engineer-in-charge. It shall be with protective cover and shall be as per approved sample in advance.

Cement Mortar : Cement shall be supplied by the Contractor. Sand or fine aggregate size 0.15 mm to 5 mm I.S. sieve No.15 to 480 confirming to relevant specification shall be supplied by the Contractor.

##### **FIXING :**

During the construction of masonry wall of the manhole the cement mortar of 1:4 shall be used for embedding the steps in the wall masonry. The spacing of steps in masonry shall be 300 mm. center to center in the staggered position in the vertical direction with two staggered rows at 385 mm center to center in the Horizontal direction. The top of the manhole shall be at least 300 mm above the last step and lowest step shall not be more than 300 mm above the benching and the center line of two benching and the center line of two staggered rows shall be the center line of the shorter of manhole frame in the roof of chamber.

Unchequered portion of the step shall be placed on the cement mortar 1:4 and masonry in C.M. 1:4 so constructed around the step as to keep the step on its right position. The non-slip grip chequered portion of the steps shall be well kept outside the masonry. The first step at the bottom shall be so kept so to have at least 500 mm above the top of the benching portion

in the bottom of the drainage chamber. Similarly as stated earlier, the last step shall be at least 300 mm away from the top of the roof of the manhole.

Steps shall be well embedded in the cement mortar 1:4 and curing shall be done as per routine at least for seven days.

During fixing of the steps, the steps shall not be damaged, and shall not vibrate or shall not shake during ascents and descents otherwise they shall have to be refixed correctly as per the drawings or as mentioned above.

**CEMENT CONCRETE (PLAIN AND REINFORCED) :**

The specification item No. 10 for nominal cement concrete of specified proportion for plain and reinforced concrete works, shall be applicable.

Water : Water shall conform as per specification for materials.

Fine aggregates : Fine aggregate shall conform as per specifications for materials.

**COARSE AGGREGATE :**

Coarse aggregate shall conform as per specifications for materials.

Size: The maximum size of coarse aggregate shall be 20 mm for reinforced concrete and 40 mm for plain cement concrete.

Generally, a maximum size of 20 mm shall be found satisfactory for reinforced concrete work.

The grading between the maximum size and minimum size and minimum size shall be such as to produce a dense concrete to specified proportion and consistency that will work readily in to the position without any aggregate and without the use of excessive water content.

**CEMENT PLASTER (ORDINARY):**

GENERAL: This specification laid down the requirements of cement plaster to be applied on concrete, brick masonry surface in cement mortar of specified proportion and specified thickness. The work shall conform to I.S. 1661-1960.

Cement Mortar : Cement mortar shall have the proportion of cement to sand 1:3 as mentioned.

Preparatory Work : All joints in the face work that is to be plastered shall be raked out to a depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done by taking care not to allow chipping of masonry in new work, the raking out shall be done when the mortar in the joints is still green. Smooth surface of concrete must be suitable roughed to provide necessary bond for the plaster. All dirt, soot oil, paint or any other materials that might interfere with satisfactory bond shall be removed.

Gauges : Patches of plaster 15 cm x 15 cm shall be put on about as gauges to ensure even plastering in one plane.

Plastering: In all plaster work, the mortar shall be firmly applied with same what more than the required thickness and well pressed in to the joints and on the surface and rubbed and levelled with a straight edges shall be freely used to ensure a perfectly plane and even surface. All corners shall be finished to their angles or rounded as directed by the Engineer. The surface shall be finished to plain curved surface as shown on the plan or as directed by the Engineer and shall present a neat appearance.

The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering shall be done in squares or stripes as directed, plastering shall be from top down ward.

Finishing in any continuous face of a well, finishing treatment of any type shall be carried out continuously and day breaks made to coincide with architectural breaks in order to avoid unrightly junctions.

Moulding : All mouldings shall be worked true to template and drawn neat, clean and level. All exposed angles and junctions with door frames, etc. shall be bedded if ordered.

Watering : All plaster and masonry work shall be kept damp continuously for a period of 14 days. To prevent excessive evaporation on the sunny or with windward side of the work in hot, dry weather, matting or gunny bags may be hung over on the outside of the plaster in the

beginning and kept moist.

If the contractor fails to water the work to the satisfaction of the Engineer, the latter may engage requisite labour, materials and equipment to water the work properly at the cost of the Contractor.

Bed Work : The mortar of the plaster peris through neglect of watering of for any default and if the work is not done as specified above, the plaster shall be removed and redone at the contractors expenses.

#### **CONSTRUCTION:**

As per line and level and size of the manhole, the manhole pit shall be excavated as per drawing or as ordered by the Engineer.

The foundation concrete 1:4:8 of required thickness as per drawing or as ordered shall be laid after compacting the bottom of the pit. The cement concrete shall conform to specified specifications.

The clear inside camber size of opening shall be as per the drawing or as directed by the Engineer-in-charge.

The masonry wall shall be plastered inside with 12 mm thick 1:3 cement mortar and outside with flush joint. The off set for the concrete foundation shall be 150 mm on all side beyond walls of chamber.

Whenever pipes enter or leave the masonry chamber Fly ash lime bricks on edge must be so laid around the upper half of the pipes so as to form the arch to prevent the weight of the masonry chamber over it.

On the top of masonry walls 1:1 cement mortar shall be laid and then 150 mm thick R.C.C. slab of grade 1:1.5:3 as necessary and as directed by the Engineer with coarse aggregate of trap metal 20 mm size shall be laid. Necessary from work and centering shall have to be provided by the contractor at his own cost.

The precast R.C.C. in M-200 manhole frame and cover shall be of approved quality and as per drawing. It shall be fixed as directed by the Engineer on the chamber over a trapezoidal shape concrete in CC 1:2:4.

Polypropylene Steps are also be fixed inside the manhole chamber in C.M. 1:4 and shall conform to approved sample.

#### **ITEMS TO INCLUDE :**

Preparing the surface to receive the plaster providing cement plaster of the specification average thickness with specified number of cost.

Dewatering when necessary, if not separately provided in the tender.

All labour, materials, use of tools and equipment's to complete the plastering as per specifications curing for 14 days.

Any moulding work, if shown on the drawings or as specified unless separately provided in the tender.

#### **For Circular manhole of I.S.I. Mark**

Outer diameter :- 860 mm

Thickness :- 175 mm

Protection for edge :- 25 x 25 x 3 mm M.S. angle shall be provided to project the edges of frame with anti-corrosive paints.

Clear Opening :- 560 mm

Tolerance :- +/- 5 mm.

Heavy duty Cover (Circular) :-

Outer diameter :- 715 mm

Thickness :- 100 mm

Lifting hooks :- 16 mm Tot Bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes.

Protection for edge :- Same as for frame.

Design Load and carrying capacity : 35 M.T.

Tolerance : +/- 5 mm

**NOTES:-**

- (i) Cover shall conform I.S. 12592 (Part-I 1988.)
- (ii) Frame shall conform I.S. 12592 (Part-II 1991)
- (iii) After production of each lot of manhole frame and cover the contractor shall send the offer letter for testing of same to Executive Engineer. The authorised representative of Executive Engineer shall select the specimens of cover as per I.S. for the load test, which should be carried out at S.V.R. College of Engineering, Surat. The specimens of frame should be checked for its reinforcement which must be provided as per detailed drawings attached with tender. The cost for testing of manhole cover and frame broken for inspection shall be born by the contractor in any case.

**MODE OF MEASUREMENT AND PAYMENT:**

Payment shall be made on the basis as per number of masonry manhole chambers constructed with all constructing materials, labour, excavation, refilling, curing, finishing providing and fixing polypropylene steps constructing, laying half round gutter, providing and fixing R.C.C. manhole cover etc. complete in all respect. Incomplete work shall not be acceptable.

The Item will be paid per number for the depth as per item for manhole. However, if depth is more or less than specified in the item, rates of payment shall be worked out as specified in Schedule-B. However, for manhole of size 3.0 x 1.2 x 2.8 m, average depth of the manhole is considered for payment.

The measurements shall be made for such number of chambers constructed.

***Item No: 7.14 Providing constructing brick masonry INLETCHAMBER***

***7.14 Providing constructing brick masonry INLETCHAMBER OF 750\*600\*1500mm internal dimension with necessary excavation refilling 350mm th Br.masonry in C.M1:4, 150mm th. p.c.c. & benching in c.c. 1:2:4, 12mm th. plaster in C.M.1:3 for inside & cement pointing in C.M.1:3 for o/s, prov. & fixing precast RCC frame & cover of M30 grade as per drawing & specification.- Rate For 1.5 mt Depth***

***Add. or ded. per every 10 cm increase or decrease in depth***

**MATERIALS:**

**WATER:** Water shall conform to M-1 of detailed specification of materials.

**SAND:** Fine aggregate 0.15 mm to 5.00 (about 0.00597 to 3/16") I.S. sieve No.15 to 480 shall conform to M-6 of detailed specifications of material.

Coarse aggregate 5 mm to 40 mm shall conform to the latest version of relevant I.S. Specification and M-12 of detailed specification of material.

**SIZE :** The maximum size of coarse aggregate shall be as large as possible normally not greater than 1/4 of the minimum thickness of concrete member. In case of R.C.C., this size present no difficulty to surround the reinforcement thoroughly and fill up the form work fully and is less than the minimum cover by 6 mm for plain concrete. Maximum size of the coarse aggregate shall be up to 40 mm subject to the above limitation and provided no limiting size is specified in the special provisions.

Generally a maximum size of 20 mm shall be found satisfactory for reinforced concrete work.

The grading between the maximum size and minimum size of 5 mm shall be such as to produce a dense concrete of specified proportion and consistency that will work readily in to position without any aggregate and without the use of excessive water content.

**CEMENT MORTAR :** Sand or fine aggregate size 0.15 to 5 mm I.S. Sieve No.15 to 480 confirming to relevant specification shall be supplied by the contractor and it shall be mixed with Portland cement in require proportion by volume. It shall be mixed dry and then requirement quantity of water shall be added before final mixing to have thoroughly mix mortar paste. Mortar shall preferably mixed in mixer.

**FLY ASH LIME BRICK :**

Fly ash lime brick shall be used for this item and shall comply with specification or relevant I.S. (latest version). Sample of Fly ash lime bricks shall be got approved by the Engineer, who will keep it in his office for reference.

**WORKMANSHIP :**

The chamber of different types and sizes as specified shall constructed in storm line at such places and such levels and dimensions as shown in drawing or as directed. PCC shall be in 1:4:8 cement concrete.

Bed Concrete : The inlet chamber shall be built in bed of cement concrete 1:2:4 as shown in drawing or as directed. The relevant specification if Item No. 10a shall be followed for 1:2:4 concrete proportion by volume.

WALLS : The walls of chamber shall be constructed using Fly ash lime bricks, having crushing strength not less than 75 Kg/Sq.cm. in C.M. 1:4 (1 Cement : 4 fine sand). The Fly ash lime brick masonry shall confirm to relevant specification of M-15A of detailed specification of material. The jointing face of such Fly ash lime brick shall be well buttered with cement mortar before laying so as to ensure that full joints are filled up with mortar.

PLASTER : The inside of wall shall be plastered with 12 mm thick C.M. 1:3 (1 Cement : 3 fine sand) and finished with floating coat of neat cement. All angles shall be rounded to 7.50 cms. radius and all rendered internal surfaces shall hard impervious finish obtained by a steel trowel. The external joints of masonry shall be finished smooth as directed.

#### **CHANNELS AND BENCHING :**

Channels shall be semicircular in the bottom half and of diameter equal to the pipe of drain. Above the horizontal of diameter the sides shall be extended vertically to the level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel with appropriate fall, suitably rounded off in the direction of flow in the main channel, shall be given.

The channel and benching shall be done in 1:2:4 grade rising at a slop in line from edges of channel. The channels of the bottom of the chamber shall be plastered with C.M. 1:2 (1 Cement; 2 coarse sand) and trowelled smooth.

FRAME FITTING: Perforated Precast R.C.C. Jali in CC M-30 as per drawing shall be fitted firmly in the precast frame which shall be laid over plaster on top of masonry. Cement mortar shall 1 part cement and 2 parts of sand and layer shall be 25 mm thick.

#### **TESTING:**

Chamber shall be tested by filling with water up to top as directed.

After completion of work, chamber covers shall be sealed by means of thick grease.

#### **MODE OF MEASUREMENTS AND PAYMENTS:**

The rate includes all labours, materials, curing for 14 days, tools and plant, etc. required for satisfactory

completion of this item as per drawing and as directed by the Engineer-in-charge.

The rate shall be for a unit of one chamber including RCC cover with frame.

### ***Item No: 7.15 Making Connection***

#### ***7.15 Making Connection (a) upto 900mm dia***

##### ***Making Connection (b) 900mm to 1600mm dia***

##### ***Making Connection (c) More than 1600mm dia***

#### **MATERIALS :**

WATER: Water shall conform to M-1. Detailed specification of material.

CEMENT: Cement shall conform to M-3. Detailed specification of material.

SAND: Fine aggregate 0.15 mm to 5.00 (about 0.00597 to 3/16") I.S. sieve No.15 to 480 shall confirm to relevant I. S. specification of latest version.

#### **COARSE AGGREGATE :**

Coarse aggregate 5 mm to 40 mm shall conform to the relevant I.S. Specification of latest version.

SIZE : The maximum size of coarse aggregate shall be 40 mm but normally not greater than 1/4 of the minimum thickness of concrete provided that in case of R.C.C. this size present no difficulty to surround the reinforcement thoroughly and fill up the gap of the form work fully and is less than the minimum cover by 6 mm for plan concrete, maximum size of the coarse aggregate shall be up to 40 mm subject to the above limitation and provided no limiting size is specified in the special provisions.

Generally, a maximum size of 20 mm shall be found satisfactory for reinforced concrete work.

The grading between the maximum size and minimum size of 5 mm shall be such as to produce a dense concrete of specified proportion and consistency that will work readily into position without any aggregate and without the use of excessive water content.

**CEMENT MORTAR :**

Sand or fine aggregate size 0.15 mm to 5 mm I.S.Sieve No.15 to 480 conforming to relevant specification shall be supplied by the contractor.

**BRICKS :**

First class fly ash lime bricks shall be used for this item & shall comply with specification of relevant I.S. (Latest version) sample of brick shall be got approved by the Engineer, who will keep it in his office for reference.

As and where required polypropylene steps shall be fixed as per Item No. 8

**WORKMANSHIP :**

Item includes excavation dismantling of B. B. masonry, plaster, C.C. breaking of existing pipe as per requirements etc. if required for jointing new storm water drain with existing drain.

B.B. masonry shall be constructed as per existing section of drain and as per instruction given by the Engineer-in-charge if necessary 20 mm thick plaster in prop. 1:2 c.m. shall be carried out 0.60 mt. either side of the joint.

**MODE OF MEASUREMENTS AND PAYMENTS:**

Item includes all internal, labour plant and tools required for it.

Rate shall be for a unit of Nos.

## **Section: 8 Miscellaneous**

### ***Item no.8.01 Excavation for pipe line trenches***

***8.01 Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified.***

***In all sorts of soil and soft murrum***

***(A) Upto 1.5 Mt. depth from G.L***

***(B) 1.5 Mt. TO 3.00 Mt. Depth***

**GENERAL:**

Any soil which generally yields to the application of pickaxes and shovels of jumbars of scarifiersphawaraa rakes or any such excavating implement or organic soil gravel, silt, sand truf loam, clay, peat etc., fall under this category.

**CLEARING OF SITES :**

The site on which the drain is to be laid shall be cleared and all obstructions, like loose, materials and rubbish of all kind, bush, wood and trees shall be removed as directed. The materials so obtained shall be the property of the Corporation and shall be conveyed and stacked as directed with 90 m. lead. The roots of the trees coming in the site shall be cut and coated with hot asphalt.

The rate of site clearance is deemed to be included in the rate of earth work for which no extra payment will be paid.

**SETTING OUT:**

All the centre line of drain trenches shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks etc. and maintain them as long as required true to line, level, curve & slopes. The contractor shall assume full responsibility for alignment, elevation and dimensions of each and all parts of the work. The labour, materials etc. required for setting out and establishing bench marks and other reference marks shall be arranged by the contractor at his own cost.

**EXCAVATION:**

The excavation for the drain trenches shall include removal of all materials of whatsoever nature and whether wet or dry, necessary for the laying of pipe lines/construction of box drain and sub-structure exactly in accordance with lines, levels, grades and curves shown on the plans L-sections. Trenches shall be excavated to the exact width at of lowest portion of the trench and the sides shall be left vertical as far as possible or according to the angle of repose of various soils. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed.

Excavation shall be carried out in strata's specified in item of schedule 'B'. The lift will be also as specified in Schedule 'B'. Excavated material shall be stacked at a minimum distance of 1.5 meters away from the edge of the trench. The leveling Instruments shall be used for checking the gradients of bed or trenches. Before the trench excavation is started, sight rails made of good timber shall fix truly vertical at a uniform height, above the invert. The centre line shall be clearly marked on the sight rails. Depth of excavation shall be checked by leveling instruments only as per instructions of the Engineer-in-charge.

The bottom of the trenches shall be leveled both longitudinally and transversely or stepped as directed by the Engineer. The contractor shall, at his own cost, remove such portion of boulders or rock, as required to make the bottom of the trench level. No filling shall be allowed to being the bottom of the trench in level. If by contractor's mistake, Excavation is made deeper than shown on the plan ordered by the Engineer, the extra depth stuff duly watered and rammed as directed by the Engineer as at the cost of the contractor. All rock or other hard foundation shall be cleared off, all soft and loose material cut to a firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and elevation of bottom of trenches and may be deemed necessary to secure satisfactory lying of pipe lines. The contractor shall at his own expense, make provision for all pumping, dredging bailing out of draining water and the trenches shall be kept free of water, during construction work.

Extra excavation to be done for joint pits shall be paid separately by SMC at the rate of the respective item of excavation but in any case extra width for excavation of Joint pits shall not exceeds 500 mm from outer face of joint on both sides as well as 100 mm in bottom and 600 mm in length on the either side.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no trench will be allowed to be filled up until the Engineer or his authorised agent approved the depths and dimensions of excavation and the nature of the strata met with and the level and/or measurements are recorded.

The work measured shall be maintained till completion and in case of collapse of sides or bottom of trenches due to any reasons, it shall be made good without any extra cost.

**PROTECTION:**

In case of excavation is to be done with sloping of stopping sides (i.e. to the given angle) as per the drawing details, then the rates for shoring and strutting shall be considered included in this item. Wherever required the shoring strutting may be done. It shall conform to specification of shoring and strutting which is explained in other item of this tender.

The drainage trenches shall be strongly fenced and red light signals shall be kept at night in charge of watchmen to prevent accidents. Sufficient care and protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution Boards etc. shall be provided by the Contractor. The wooden planks for crossing trenches by public as per requirement shall be provided by the contractor without any extra cost.

#### **ADDITIONAL REQUIREMENTS :**

At the joints drain the trench shall be excavated to an additional depth of 15 cms. and width of 30 cms. and length of 15 cms. beyond the edge of collar on both the sides or as directed by Engineer-in-charge. The rate includes for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of trench shall be kept as per invert level or as directed. In obtaining formation on the bottom trench, the usual method of leveling instruments shall adopted. The contractor shall have to provide and maintain leveling instruments without any extra cost.

If case of emergencies such as unexpected rains, important public occasions, dangers to properties etc. the contractor shall be required to fill up the excavation with necessary consolidation, which may be re-excavated for flow test and refilled for which no extra claim for payment and time limit shall be entertained.

If contractor fails or makes delay to give the flow test of the pipe line laid line any of the section, without any genuine reasons, he shall be responsible to get re-excavate any part of the length of trenches refill in such case (i.e. before testing for safety of pedestrian and / or vehicular traffic) as found necessary be the Engineer-in-charge without any extra cost, if found necessary and as directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during flow test without any extra cost.

In case of excavation across a road, permission of road authorities shall have to be obtained. At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipe line making it suitable for the traffic. The contractor shall provided diversion when the pipe line is to be laid along the road as required and shall maintain the diversion or any part of it, of damaged without any extra cost. At all road crossings, the pipe shall be laid below the crust of the road.

The contractor shall break the road surface by Excavation of chiseling to the exact width and length as shown on the drawing. Separate provision should be made for cutting of road surface. However this item shall be paid separately as mentioned in Item No.1 or 2 whichever is applicable.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at no objectionable place.

The contractor shall have to make his own arrangements for taking trial pits etc. at his own cost, as directed by the Engineer-in-charge.

If necessary, temporary arrangements shall have to be made to divert or convey across all natural water ways or build up drains etc. without any extra cost.

All water pipes, cables; any structure shall be protected by the contractor as directed by the Engineer-in-charge, if met during excavation. Any damage caused shall be rectified without any extra cost.

Breaking of brick structures/R.C.C. works, cement concrete etc. coming in excavation shall be considered as excavation in strata shown in the item, as above and will be paid at the same rate.

All safety precautions shall have to be made by the Contractor.

The excavation in narrow streets, lanes shall have to be carried out with full precautions so as that no property may be damaged. Any compensation to be paid to the other party will be paid by the contractor for which the Surat Municipal Corporation will not be responsible.

All obstacles, structures etc. shall be removed and made good without further claim or extra cost.

#### **DISPOSAL OF EXCAVATED STUFF:**

No excavated stuff from foundation trenches of whatever kind they shall be placed even temporarily nearer 1.5 meter distance prescribed by the Engineer from the outer edge of excavation. The rate of excavation includes sorting out of useful materials and stacking them separately as directed within specified lead. The material suitable and useful for backfilling or other use shall be stacked in convenient places but not in such a way as to obstruct free of movement of men, animals and vehicles of encroach upon the area required for constructional purpose. The site shall be kept clean of all debris on completion of the work.

Disposal of excavated materials is subject to the following. Useful materials obtained from cleaning site and excavation shall be stacked within a lead of 90m. Beyond the building area as directed. Materials suitable for back filling shall be stacked at convenient places with in a lead of 90 m from the structure for reuse. Useful stones from excavation shall be stacked nearly within lead of 90 m. and will allowed to be used by the Contractor on payment at rates laid down in the contract or if not so laid down at scheduled rates of the corporation or at a mutually agreed rates if there are no such rates in the schedule of rates.

#### **DEWATERING:**

Any water which may accumulate in the excavation during the progress of the work, either, by percolation, seepage, springs, rain or any other cause shall be bailed out by pumping and diverting surface flow if any by earthen binds or by any other means. The bunds shall be removed as soon as the work is completed.

The Contractor shall provides, maintain and operate sufficient number pumping equipment of approved capacity to keep the area of construction free from water and any sub soil water arising during the construction period.

Pumping shall be so controlled to dispose of water from adequate drainage ditches and shall not be rated so as to make in convenience in constructional operations in general. Precaution shall be taken by the Contractor to prevent any damage to the trench, pipe line of adjustment structure.

The excavation shall be kept free from water by the contractor (1) During excavation (2) When pipe laying and construction of joints are in progress and till the Engineer-in-charge considers that the mortar is sufficiently set. (3) During hydraulic testing inspection and measurements.

The contractor shall be paid separately for dewatering exceeds 5 HP.Hr. as per rate mentioned in Schedule-B.

#### **MEASUREMENT AND PAYMENT:**

The payment of a various classes of excavation, depending upon the depth of excavation, shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer limited to dimensions shown in the sanctioned plans L-Section or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured nor paid for and if so ordered by the Engineer. The contractor shall have to fill up the excess depth with selected excavated stuff duly watered and rammed as directed by the Engineer-in-charge without any extra payment to the Contractor.

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

The rate for the item of excavation shall include (Unless and otherwise mentioned).

- (a) Clearing of site.
- (b) Setting out work including all materials and labour.
- (c) Refilling the drain trenches with approved materials and watering & consolidating up to original ground level.
- (d) Providing facilities for inspection and measurements at any time by the concerned Corporation Officials.
- (e) Compensation for injury to life and damage to property if caused during progress of work.

All measurement shall be take true vertical depth from bottom of pipe (i.e. I.L. + thickness of pipe).

#### ***Item no.8.02 Providing , Carting, Conveying, Stacking, Lowering, Laying and Jointing of ISI Standard NP 2 and NP 3 class RCC pipes***

***8.02 Providing , Carting, Conveying, Stacking, Lowering, Laying and Jointing of ISI Standard R.C.C.pipes conforming to relevant IS Code & marked on it in standard lengths of following class and diameter suitable for either collar joints or rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.***

***Note: One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.***

- (A) 150 mm dia (NP2 Class)-For Connection Line***
- (B) 250 mm dia (NP3 Class)***
- (C) 300 mm dia (NP2 Class)***

**(D) 300 mm dia (NP3 Class)**

**(E) 450 mm dia (NP3 Class)**

**CLAUSE 1013 REINFORCED CONCRETE PIPES AS PER MORT&H**

In place of existing Para, substitute the following:

Reinforced concrete pipes for roadway structures shall be of the class specified by the designer for the particular application. In absence of such specification, the class shall be NP 2 and NP3 type conforming to the requirements of IS: 458-2003.

Measurement for this Item shall be RM and rates will be as indicated in BOQ.

***Item no.8.03 Providing and constructing rectangular brick masonry chamber***

***8.03 Providing and constructing rectangular brick masonry chamber for house connection as per type design in brick masonry in C. M. 1:3 including M-100 in foundation M-150 in benching inside plastering in C. M. 1:3 and outside plastering in C. M. 1:3 coping in M200 and fixing RCC precast manhole frame and covers, but Excl. supply of manhole and cover etc. complete excl. excavation.***

Mode of Measurements and payments:-

[1] The rates including all labors, materials, tools and plats etc. required for satisfactory completion of this work. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sqm.

[2] The rate shall be for a unit of one number.

***Item no.8.04 Providing & supply of R.C.C. precast M.H. frame & cover***

***8.04 Providing & supply of R.C.C. precast M.H. frame & cover-Light duty for house connection chamber.***

Mode of Measurements and payments:-

The rate shall be for a unit of one number.

***Item no.8.05 Providing and Fixing RCC precast inlet chamber cover***

***8.05 Providing and Fixing RCC precast inlet chamber cover of M-30 Grade as per drawing and specification.***

***(A) Size-750 mm x 600 mm***

***(B) Size-600 mm x 450 mm***

Providing and Fixing RCC precast inlet chamber cover of M-30 Grade as per drawing and specification.

Mode of Measurements and payments:-

The rate shall be for a unit of one number.

***Item no.8.06 Removing and resetting Existing paver block***

***8.06 Removing and resetting Existing paver block, including all watering leveling, cleaning, labour & Equipments chagres etc. complete as per details in tender specification & as directed by engineer in charge.***

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Removing and resetting Existing paver block, including all watering leveling, cleaning, labour & Equipments chagres etc. complete

Mode of Measurements and payments:-

The rate shall be for a unit of Sq.Mt..

***Item no.8.07 Removing& resetting existing ready made C.C. Kerb***

***8.07 Removing & resetting existing ready made C.C.Kerb of strength of required size & thickness in line,level and truly vertical position ,including filling joints in C.M.1:1(1part of cement 1 part of coarse sand) smooth pointing in C.M.1:1 (1part of cement : 1 part of stone dust )including watering etc.complete as directed by engineer-in-charge.***

Refer description as mentioned Item No. 8.06

***Item no.8.08 Providing and fixing steel work***

***8.08 Providing and fixing steel work welded in built up section, framed work including cutting, hoisting and fixing in position and applying priming coat of red lead paint. fabrication.***

All steel work shall conform to IS : 800-1984 (reaffirmed 1998) or latest edition and shall be free from defects impairing strength, durability or appearance and shall be of the best quality for the purpose specified, and possessing structural properties to withstand safely stresses to which these shall be normally subjected. The contractor shall bear the costs of the tests.

All structural steel members brought by the contractor shall be handled with care, stacked on edge and supported evenly.

The structural steel and rivet bars shall conform to latest edition of IS: 226. Before any fabrication work is commenced all plaster shall be flattened and all bars and sections be straightened or otherwise trued and made free from twist or other distortion. Method adopted for the purpose shall be such as not to inure the material. Cutting shall be the responsibility of the contractor.

The contractor will have to submit shop drawings to the Architect/ Consultant. All shop drawing shall be prepared in advance of the drawing actual fabrication. These shall show full size sections and all joints and connections, thickness of materials used and details of welds, bolts. rivets etc. Shop drawings shall clearly distinguish between, shop and field rivets, bolts and welds. Drawing shall be made in conformity with the IS: code for shop drawings and with due regard to speed and economy in fabrication and erection. A making diagram allotting distinct identification marks to each separate piece of steel shall be prepared. The diagram shall be sufficient to ensure convenient assembly and erection at site. All shop drawings shall show temporary bracing and connections required fabrication and erection.

**Riveting :**

All holes in platers or section over 12 mm thick must be drilled and not punched and accurately gauged. All hole (except in purlins, runners, packing plates, lacing bars) shall be drilled to required size. All matching holes for rivets or black bolts shall be such that a gauge

0.8 mm less in diameter that the hole can pass freely through members assembled for riveting and bolting. All holes for turned and fitted bolts shall be drilled and reamed, if necessary, to tolerance of only plus 0.13 mm when the number of thickness to be riveted exceeds three or the total thickness is 90 mm. or more the holes shall be drilled or reamed in position after assembly, except when the steel bushed jigs are used. Parts shall be firmly held together during such block drilling and taken apart for removal of burrs, after drilling.

All parts assembled for riveting shall be in close contact and all bearing stiffeners shall bear tightly at both top and bottom without being drawn or caulked. All parts of riveted members shall be temporarily pinned or bolted while riveting. Drifting of holes shall not be permitted except to draw the part together and no drift used shall not be larger in any part than the normal diameter of

rivet or bolt. Drifting done during assembling shall not distort metal or enlarge hole. Rivets when cold shall be size shown on drawing and shall preferably fill the hole and from the head of standard dimension unless otherwise stated. All riveting wherever practicable shall be done by the hydraulic or pneumatic process. All loose, burnt or badly formed rivets with eccentric or deficient heads shall be cut and replaced by sound rivets. Counter sunk heads shall be provided wherever required. Caulking and recupping shall not be permitted.

**Bolting :**

All turned and fitted bolts shall be parallel throughout the barrel within the tolerance of only minus 0.13 mm and faces of heads and nuts bearing on steel work shall be machined. All such bolts shall be provided with washers of standard size so that the nut when turned shall not bear on the unthreaded body of the bolt. Heads and nuts shall be hexagonal with smooth screws and shall be well formed. Where the full bearing area of the rivet is to be developed, the threaded portion of

the bolt shall not be within the thickness of the parts bolted together. Threaded portion of each bolt shall project beyond the nut at least by one thread. Tapered washers shall be provided for all heads and nuts bearing on beveled surfaces.

**Welding :**

Welding wherever indicated shall conform to latest edition of IS: 814-1963 unless otherwise specified. Welding shall be carried out by experienced welders only, who if necessary, shall produce testimonials about their work or if required by Architect/Consultant shall have to undergo qualifying tests as prescribed in latest edition of IS: 1181. Welding work shall be carried out as per latest edition of IS: 818.

Welding shall be done in flat position wherever possible and adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work.

Steel shall not be painted or oiled and any areas where welding is to be performed shall be well cleaned to remove any paint, scale or rust immediately before welding for a distance of at least 2cm (3/4") on either side.

The work shall be securely held in position by means of tack welds, service bolts, clamps or jigs before commencing the welding so as to prevent any relative movement due to distortion, wind or other causes. When welding is liable to cause distortion, the work shall be securely held in approved frames or jigs.

Parts to be filler welded shall be brought in as close contact as practicable and in no event shall be separated more than 4.75 mm (3/16"). If the separation is 1.6 mm (1/16"), or greater, the size of the fillet welds shall be increased by the amount of the separation.

The separation between facing surfaces of lap joints shall not exceed 1.6 mm (1/16"). The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting.

Abutting parts to be butt welded shall be carefully aligned. Misalignment greater than 3 mm(1/8") shall be corrected and in making the correction, the parts shall not be drawn a sharper slope than two degrees (11mm in 30 cm or 7/16" in 12").

The sequence of welding shall be such that when possible the members which offer the greatest resistance to compression are welded first.

Welded joints showing slag inclusion or lack of proper penetration shall be cut and rewelded overlap of the toe of the weld and undercutting of the parent metal should be avoided and where present to a serious extent shall be rectified.

All slag shall be removed from each run before another run is superimposed. When cold the final run shall be protected with clean boiled linseed oil and shall not be painted until approved by the Architect/Consultant or his representative.

Grinding of finished weld is permitted provided the weld is not reduced below the prescribed section. All exposed welds shall be ground smooth. Welds which have not been ground shall be scrubbed with a 10% solution of Hydrochloric acid which shall be washed off with before paint is applied an alkali resisting paint is used.

Other IS codes:

IS 812: 1957 (revised 1998)

IS 817 (Part 1 & 2) – Training of Welders – code of practice

**Fabrication and Erection:**

In order to facilities handling, transportation and execution contractor may fabricate structural members in suitable sections. The details of site connection and their location shall be approved by the Architect/Consultant.

Frame or lattice section intended for use as parts of composite construction which are likely deflect considerably during handling shall be suitably stiffened by means of steel angles.

Roof and other structure shall be supported at close intervals during the welding/bolting or site connections.

The frame of steel skeleton building shall be carried up true and plumb and temporary bracings shall be introduced wherever necessary to take care of all loads to which structures may be subjected including erection equipment and operation of the same, such bracing shall be kept in position as long as required for safety or as deemed necessary by the Architect/Consultant.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind load and erection stresses. No riveting or welding shall be done until the structure has been

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properly aligned. Rivets driven in field shall be heated and driven with the same care as those driven in the shop.

In the setting or erection of steel work the individual pieces shall be considered plumb or level when error does not exceed 1 to 500. For exterior columns the error shall not exceed 1 to 1000.

Slight bends in the members of fabricated structure shall not be straightened unless strictly necessary on account of danger of overstraining connection and rivets, weld or bolts. Connection plates, if slightly bent or twisted shall be straightened cold. If bent so sharply as to require heating the whole piece thus heated shall be subsequently annealed. No straightening whatsoever shall be carried out without the previous sanctions of the Architect / Consultant / Engineer in charge.

**Expansion Gaps:**

Particular care must be taken to ensure free expansion and contraction, whatever provide for drawing or special specification.

**Painting:**

Painting of steel structure shall be carried out as per detailed specification under painting.

**Painting Joints:**

The surface of all joints must be thoroughly scrapped cleaned and given the first coat of red lead paint before joining up which should be done while the paint is still wet. The procedure shall not apply to welded joints. All rivets, bolts, washers, etc shall be thoroughly cleaned and dipped in boiled linseed oil. All machined surfaces shall be well coated with a mixture of white lead and tallow.

**Measurements:**

All fabricated trusses, frames, gantry girders, crane rails, fishplates, and clamps, square or round bars etc. Stanchions built girders and purlins shall be calculated on the basis standard net weight according to I.S.I. code. Net weight of clean, brackets, packing pieces, rivets, bolts distance pieces, separators, gussets holding down bolts, fish plates etc shall be added to the respective items. No deduction shall be made for holes, bolts or rivets and waste involved in cutting or nothing ends of sections or intermediate points for making connections. Weights for the bolts and nuts shall be measured but the weight of the weld shall not be considered. The rates shall be inclusive of all plants and heavy machinery required for its erection like cranes, temporary structures, concrete blocks, pulleys, hydraulic jacks etc.

**General**

Unless otherwise specified, all metal work shall be given approved shop coats as well as field coats of painting. The item of work shall include preparation of metal surfaces, application of protective covering and drying of the paint coatings along with all tools, scaffolding, labour and materials necessary.

Coatings shall be applied only to dry surfaces and the coated surfaces shall not be exposed to rain or frost before they are dry. The coatings shall be applied to all surfaces excluding shear connectors and inner surfaces of fully sealed hollow sections. While coating adjacent surfaces, care shall be taken to ensure that primer is not applied on the shear connectors.

**Types of Paints**

**i) Ordinary Paints:** These include paints based on drying oils, alkyd resin, modified alkyd resin, phenolic varnish epoxy, etc.

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**Ordinary painting can generally be sub-divided into two types:**

**a) Primary Coats:** This shall be applied immediately after the surface preparation and should have the properties of adhesion, corrosion inhibition and imperviousness to water and air.

**b) Finishing Coats:** This shall be applied over the primary coat and should have the properties of durability, abrasion resistance, aesthetic appearance and smooth finish.

**ii) Chemical Resistant Paints**

The more highly corrosion resistant paints can be divided into two main groups :

**a) One pack paints (ready for use)**

**b) Two pack paints (mixed before use)**

The two pack paints shall be mixed together just before use since they remain workable thereafter only for a restricted period of time.

**iii)** Other types of paints as mentioned in Clause 1903.4 of this Section may also be used, subject to approval by the Engineer.

All paints shall conform to relevant IS Standards as appropriate.

Surfaces which are inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled for riveting.

All rivets, bolts, nuts, washers etc., are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS:77.

All machined surfaces are to be well coated with a mixture of white lead conforming to IS:34 and mutton tallow conforming to IS:887.

In site painting, the whole of the steel work shall be given the second covercoat after final passing and after touching up the primer and cover coats, if damaged in transit.

**Quality of Paint**

Only paints which have been tested for the following qualities as per the specifications given in the relevant IS codes, should be used :

- Weight test (weight per 10 litre of paint thoroughly mixed)
- Drying time
- Flexibility and adhesion
- Consistency
- Dry thickness and rate of consumption

Unless otherwise specified, all painting and protective coating work shall be done in accordance with IS:1477 (Part 1).

**Surface Preparation**

Steel surface to be painted either at the fabricating shop or at the site of work shall be prepared in a thorough manner with a view to ensuring complete removal of mill scale by one of the following processes as agreed to between the fabricator and the Engineer :

a) Dry or wet grit/sand blasting

b) Pickling which should be restricted to single plates, bars and sections

c) Flame cleaning

Primary coat shall be applied as soon as practicable after cleaning and in case of flame cleaning, while the metal is still warm.

All slag from welds shall be removed before painting. Surfaces shall be maintained dry and free from dirt and oil. Work out of doors in frosty or humid weather shall be avoided.

### **Coatings**

Prime coat to be used shall conform to the specification of primers approved by the Engineer. Metal coatings shall be considered as prime coats. Primer shall be applied to the blast cleaned surface before any deterioration of the surface is visible. In any case, the surface shall receive one coat of primer within 4 hours of abrasive blast cleaning.

All coats shall be compatible with each other. When metal based coatings are used, the undercoat shall be compatible with the concerned metal base. The undercoat and finishing coat shall preferably be from the same manufacturer. Successive coats of paints shall be of different shades or colors and each shall be allowed to dry thoroughly before the next is applied. Particular care shall be taken with the priming and painting of edges, corners, welds and rivets. Typical guidelines for epoxy based paints and the conventional painting system for bridge girders as given below, may be complied with :

#### **a) Epoxy Based Painting**

i) **Surface preparation:** Remove oil/grease by use of petroleum hydrocarbon solution (IS:1745) and grit blasting to near white metal surface.

ii) **Paint system :** 2 coats of epoxy zinc phosphate primer = 60 micron: Total 5 coats = 200 micron

#### **b) Conventional Painting System for areas where corrosion is not severe Priming Coat :**

One coat of ready mixed, red lead primer conforming to IS:1021

**Or**

One coat of ready mixed zinc chrome primer conforming to IS:104 followed by one coat of ready mixed red oxide zinc chrome primer conforming to IS:2074

**Or**

Two coats of red oxide zinc chrome primer conforming to IS:2074.

#### **Finishing Coats :**

Two cover coats of red oxide paint conforming to IS:123 or any other approved paint shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second coat shall be given after touching up the primer and the cover coats; if damaged in transit.

#### **c) Conventional Painting System for areas where corrosion is severe Priming Coat :**

Two coats of ready mixed red lead primer conforming to IS:102 or One coat of ready mixed zinc chrome primer conforming to IS:104 followed by one coat of ready mixed zinc chrome primer conforming to IS:2074.

#### **Finishing Coats :**

Two coats of aluminium paint conforming to IS:2339 shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel

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work is erected at site, the second coat shall be given after touching up the primer and the cover coats, if damaged in transit.

**Painting in the Shop**

All fabricated steel shall be painted in the shop after inspection and acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanized surfaces.

Shop contact surfaces, if specifically required to be painted, shall be brought together while the paint is still wet.

Field contact surfaces and surfaces to be in contact with cement, shall be painted with primer only. No paint shall be applied within 50 mm of design location of field welds. Paint shall be completely dry before loading and transporting of the fabricated steel work to site.

Surfaces not in contact but inaccessible after shop assembly shall receive the full specified protective treatment before assembly.

Where surfaces are to be welded, the steel shall not be painted or metal coated within a suitable distance from any edges to be welded, if the specified paint or metal coating would be harmful to welders or is likely to impair the quality of site welds.

Exposed machined surfaces shall be adequately protected

**Painting at Site**

Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat.

Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets. Specified protective treatment shall be completed after erection.

**Methods of Application**

The methods of application of all paint coatings shall be in accordance with the manufacturer's written recommendation and shall be as approved by the Engineer. Spray painting may be permitted provided it will not cause inconvenience to the public and is appropriate to the type of structure being coated. Areas inaccessible for painting and areas shaded for spray application, shall be coated first by brushing.

Oil based red lead primers must be applied by brush only, taking care to work into all corners and crevices.

The primer, intermediate and finishing coats shall all be applied so as to provide smooth coatings of uniform thickness. Wrinkled or blistered coatings or coatings with pinholes, sags, lumps or other blemishes shall not be accepted. Where the Engineer so directs, the coating shall be removed by abrasive blast cleaning and replaced by the Contractor at his own cost.

## Protective Coatings in Different Environments

Since the severity of corrosion depends upon atmospheric conditions and these vary enormously, there is no single protective system or method of application that is suitable for every situation.

*Upper Table gives guidelines for various types of coatings to be used in various environmental conditions. Approximate life to first maintenance is also indicated.*

### *Item no.8.09 Providing and applying two coats of synthetic enamel paint*

*8.09 Providing and applying two coats of synthetic enamel paint to Steel railing as per Technical Specification and as directed by the Engineer.*

Paint specification and as directed by Engineer-in-charge.

### *Item no.8.10 Providing and laying in-situ PCC*

*8.10 Providing and laying in-situ PCC M20 grade cement concrete in foundations of Railing including formwork, transporting, placing, compacting, finishing, curing, etc. complete with all leads and lifts as per drawing & specification and as directed by Engineer.*

Materials:-

Water shall conform to M-1, Cement shall conform to M-3. Sand shall conform to M-5. Grit shall conform to M-6. Graded stone aggregate 20 mm nominal size shall conform to M-9.

General:-

The concrete mix is not required to be designed by preliminary tests. The proportion of the concrete mix shall be 1:1 1/2:3 [1 cement:1 1/2 coarse sand:3 graded stone aggregate 20 mm nominal size] by volume. Concrete work shall have exposed concrete surface or as specified in the item.

The designation of ordinary concrete shall be M-100, M-150, M-200, M-250 as specified in the I.S. corresponding approximately to 1:3:6, 1:2:4, 1:1:1, 1:1 1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively with conforming to IS:456.

The ingredients required for ordinary concrete work, containing one bag of cement of 50 kg. by weight [0.0342 cu.m.] for different proportions of mix shall be as under.

Grade of concrete	Total quantity of dry aggregate by volume per 50 kg. of cement to be taken as the sum of individual volume of fine and coarse aggregate maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement maximum
M-100 [1:3:6]	300 litres	Generally 1:2 for fine aggregate to	34 litres
M-150 [1:2:4]	220 "	Coarse aggregate by volume but subject	32 "
M-200 [1:1.5:3]	160 "	to and upper limit of 1:1 1/2 & lower	30 "
M-250 [1:1:2]	100 "	limit 1:3	27 "

The water cement ratios shall not be more than those specified in the table. The cement content of the mix specified in the table shall be increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction so that the water cement ratio specified in the table is not exceeded.

Workability of the concrete shall be controlled by maintaining a water cement ratio that is found to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty with the means available.

The maximum size of coarse aggregate shall be as large as possible within the limits specified but in no case greater than one fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

For reinforced concrete work, coarse aggregates having a nominal size of 20 mm generally considered satisfactory.

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

Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important and the nominal maximum size may sometimes be as greater than the minimum cover.

Admixture may be used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time; neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures.

#### WORKMANSHIP:

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

In case of beam and slab construction, sufficient number of precast cover blocks in cement mortar 1:2 [ 1 cement 2 coarse sand ] about 4 x 4 cms. section of thickness equal to the specified cover shall be placed between the bars and shuttering as to secure and maintain the requisite cover of concrete over the reinforcement.

In case of cantilevered or doubly reinforced beams or slabs, the main reinforcing bars shall be held in position by introducing cabin spacers or supports bars at 1.0 to 1.2 meters centers.

In case of columns and wall, the vertical bars shall be kept in position by means of timber template with slots accurately cut in them, the templates shall be removed after concreting has been done below it. The bars may also be suitably tied by means of annealed steel wires to the shuttering to maintain their position during concreting.

All bars projecting from pillars, columns, beams, slabs etc. to which other bars and concrete are to be attached or bounded to later on, shall be protected with a coat of thin neat cement grout, if the bars are not likely to be incorporated with succeeding mass of concrete within the following 10 days. This coat of thin neat cement shall be removed before concreting.

#### Proportioning:-

Proportioning shall be done by volume, except cement which shall be measured in terms of bags of 50 kg. Weight. The volume of one such bag being taken as 0.0342 cu. meters. Boxes of suitable sizes shall be used for measuring sand and aggregate. The size of the boxes [internal] shall be 35x25 cms. and 40 cms. deep. While measuring the aggregate and sand, the boxes shall be filled without shaking, ramming or hammering.

The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulking shall be made.

#### Mixing :-

For all work, 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. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After about half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shown complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than two minutes after all ingredients have been put into the mixer.

When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Specified quantity of water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing, quantity of cement shall be increased by 10 percent above that specified.

Mixer which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch, unless otherwise agreed to by the Engineer-in-charge. The first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement concrete to another.

Consistency :

The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump test in accordance with I.S. 1199 : 1959. The slump of 10 mm to 25 mm shall be adopted when vibrators are used and 80 mm when vibrators are not used.

Inspection :

Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men, machinery, materials and for results obtained. Immediately before concreting, all forms shall be thoroughly cleaned.

Centring design and its erection shall be got approved from the Engineer- in- charge. One carpenter with helper shall invariably kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile platform shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose.

Transporting and laying :-

The method of transporting and placing concrete shall as approved. Concrete shall be so transported and placed that no contamination segregation or loss of its constituent material takes place.

All form work shall be cleaned and made free from standing water dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of structure until the approval of Engineer-in-charge.

Concreting shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the Engineer-in-charge concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meters when internal vibrators are used and not exceeding 0.30 meters in all other cases. Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters.

When trunking or chutes are used they shall be kept close and used in such a way as to avoid segregation. 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, this 13 mm layers of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where 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 layers 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 spot.

All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer - in - charge for exceptional cases such as concreting under water where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns.

Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. Within 30 minutes of addition of water to dry mixture during compaction. It shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

Curing:-

Immediately after compaction, concrete, weather including rain, running water, shocks, vibration, traffic, rapid temperature changes frost and drying out process it shall be covered with wet sacking, hessian or other similar absorbent material approved, soon after the initial set and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days

Sampling and Testing of concrete :-

Samples from fresh concrete shall be taken as per IS 1199:1959 and cubes shall be made, cured and tested at 7 days and 28 days as per requirements in accordance with IS 516:1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following.

Quantity of concrete in the work	No. of samples
1-5 Cmt.	1
6-15 Cmt.	2
16-30 Cmt.	3
31-50 Cmt.	4
51-and above sample for each additional 50 cmt. or part thereof.	4+one additional

Note:- At least one sample shall be taken from shift. The test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of the concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

The average strength of the group of cubes cast for each day shall not be less than the specified cube strength of 150 kg/cm<sup>2</sup> at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportion given for a particular grade does not yield the specified strength such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the proportions given for a particular grade shall not, however, be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

Stripping:

The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time for removal of form work, due consideration shall be given to local conditions, character of the structure, the weather & other conditions that influence the setting of concrete and of the materials used in the mix. In normal circumstances [generally where temperatures are above 20°C] and where ordinary concrete is used forms may be struck after expiry of period specified in the Item No.4 for respective item of form work.

All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soffits are removed, the concrete surface shall be exposed, where necessary in order to ascertain that the concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

Immediately after the removal of forms all exposed bolts etc. Passing through the cement member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and, the resulting hole shall be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depression, honeycomb spots, broken edges or corner and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and so as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which are pointed shall be kept moist for a period of 24 hours.

If rock pockets/honeycombs in the opinion of the Engineer-in-charge 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 portions of the structure affected. Mode of measurement and payment:

The consolidated cubical contents of concrete work as specified in item shall be measured. The concrete laid in excess of section shown on drawings or as directed shall not be measured. No deductions shall be made for.

[a] Ends of dissimilar materials such as joints, beams, posts, girders, rafters, purline, trusses, corbels and steps etc. up to 500 sq.cm. in section.

[b] Opening up to 0.1 sq.m.

[c] The volume occupied by reinforcement shall not be deducted from R.C.C. work.

The rate includes cost of all materials labour, tools and plant required for mixing, placing in position vibrating and compacting, finishing as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate excludes the cost of form work.

The rate shall be for a unit of one cubic meters.

### ***Item no.8.11 Conveying, lowering, laying and jointing C.I./D.I. Pipes***

***8.11 Conveying, lowering, laying and jointing C.I./D.I. Pipes with specials of following dia. In proper position, grade and alingment as directed by Engineer in charge incl. Conveyance from stores to site of work, labour etc. comp.***

***(a) 100 mm Dia.***

***(b) 150 mm Dia.***

***(c) 200 mm Dia.***

***(d) 250 mm Dia.***

***(e) 300 mm Dia.***

***(f) 350 mm Dia.***

***(g) 400 mm Dia.***

***(h) 450 mm Dia.***

***(i) 500 mm Dia.***

***(j) 600 mm Dia.***

The materials shall be carted from any stores to the site by the contractor very carefully. The handling while carting the pipes, specials, valves etc. shall be done carefully. Damaged material will not accepted by Surat Municipal Corporation.

The surplus materials, after the work is over shall be immediately carted by the contractor to the stores and he shall have to obtain the receipt from the stores.

In case of heavy pipes, specials etc. lowering shall be done with the help of the chain-pully block.

Specials and sluice valves shall be fixed in position and right to the plump and perfectly water tight. The pipe and specials shall be laid in such a way that socket shall receive the spigot in the bottom of the socket perfectly. No curve shall be negotiated in the socket unnecessarily.

At the end of the day's work, no joints shall be kept open without spun yarn properly caulked, preferably all the joints should be filled in with lead by the close of day's work. All open ends shall be closed by wooden plugs or C.I. plugs or jute bags as directed by the Hydraulic Engineer. Wooden plugs/C.I. plugs/Jute bags are to used by the contractor at his own cost.

The pipes shall be laid out along the side of the trench with each pipe in its proper position for laying with an extra pipe after every 20 mt. to allow for cutting if necessary where the trench prop is inadmissible, the pipes shall be stacked in heaps at each or sufficient to fill in the length. Small pipes below 100 mm. diameter may be stacked in heaps at every 30 mt. As far as possible, pipes shall be laid straight in rising or falling gradient. It should be possible to empty the pipe readily and completely.

The socket end of the pipe shall be facing up hill. All the pipes shall be used in standard lengths as far as possible cut lengths may be used only where necessary to make up the extra length. All the pipes shall be first inspected for any damage and cracks. No cracked or damage pipes shall be used. The pipes shall be thoroughly cleaned with brushes to remove any

accumulated stones or soil inside and the inside of socket and the outside of the spigot shall also be cleaned similarly.

The pipes shall then be lowered on to the trench and the spigots neatly placed in to the sockets for full length and properly supported. The pipes shall be carefully packed under neath so that they shall bear properly throughout their whole length. The entire pipe length shall be supported on the trench bed evenly throughout item includes tyton joints also.

Mode of measurement and payment:

The rate shall be paid in Rmt. Basis. No extra cost shall be paid for fixing rubber ring tyton joint.

### ***Item no.8.12 Conveying, lowering and fixing Sluice valve/Butter fly valve/Scour valve***

***8.12 Conveying, lowering and fixing Sluice valve/Butter fly valve/Scour valve including making flange joints, tightening the nut and bolts perfectly water tight it by using rubber insulation etc complete as directed by the engineer in charge.***

***(a) 100 mm Dia.***

***(b) 150 mm Dia.***

***(c) 200 mm Dia.***

***(d) 250 mm Dia.***

***(e) 300 mm Dia.***

***(f) 350 mm Dia.***

***(g) 400 mm Dia.***

***(h) 450 mm Dia.***

***(i) 500 mm Dia.***

***(j) 600 mm Dia.***

Installation of valve:

The Sluice valve/Butter fly valve/Scour valve shall be conveyed carefully by the contractor at his cost to the site of work from any S.M.C. stores within Surat city limit. Any damage while transporting of Sluice valve/Butter fly valve/Scour valve or any other materials shall not be accepted and this have to be bare by the contractor. Valves shall be lowered and fixed in proper position and right to the plumb and flange joints with the sets of tail pieces shall be carried out perfectly water tight, rubber insertion etc. required for jointing shall be provided by the Contractor.

Mode of the measurement and payment:-

The rate shall be for unit of one number.

### ***Item no.8.13 Making lead joint***

***8.13 Making lead joint perfectly water tight. etc. complete. Lead and spun yarn shall be issued free of cost.***

***(a) 100 mm Dia.***

***(b) 150 mm Dia.***

***(c) 200 mm Dia.***

***(d) 250 mm Dia.***

***(e) 300 mm Dia.***

***(f) 350 mm Dia.***

**(g) 400 mm Dia.**

**(h) 450 mm Dia.**

**(i) 500 mm Dia.**

**(j) 600 mm Dia.**

**(k) 700 mm Dia.**

**(l) 750 mm Dia.**

**(m) 900 mm Dia.**

The outside of the spigot and the inside of the socket shall be thoroughly cleaned with a brush. The spigot shall be carefully centered in the socket by spun yarn twisted in to ropes of uniform thickness. The rope shall be well caulked into the back of the socket to leave a sufficient depth for lead as directed by the Engineer-in-charge.

The lead shall be used as specified in Table-1 of Indian Standard 3114/1965. The lead and spun yarn required for lead joint shall be shall be issued free of cost.

#### CONSUMPTION STATEMENT FOR PIG LEAD & SPUN YARN

Dia.of pipe in mm	Spun Yarn (Kg.)	Pig Lead (Kg.)
750	1.50	24.00
600	1.20	19.00
500	1.00	15.00
450	0.95	14.00
400	0.85	9.50
300	0.48	7.20
250	0.35	6.10
200	0.30	5.00
150	0.20	3.40
100	0.18	2.20
80	0.10	1.80

In case if the lead & spun yarn consumption is not with in the limit of +/- 5% the double recovery/penalty shall be made by considering the basic rate of lead as Rs.200.00/-Kg & spun yarn 65.00/Kg.

The proper depth of each joints shall be as specified and tested before running the lead by passing completely around it a wooden gauge notched out to the correct depth of lead.

The leading of joints shall be done by means of ropes covered with clay or a by using special leading rings. The lead shall be melted rendering it thoroughly fluid and each joints shall be filled in one pouring.

After a section of convenient length has been leaded, caulking shall be commenced. The lead shall be freed from the leading pipe outside of the socket of the other pipe, with a flat chisel and then caulked round three separate time with the proper caulking tools of increasing thickness and hammer 2 to 3 kg weight in such a manner as to make the joints sound shall be left flush neat and even with the socket.

The spun yarn and lead shall be issued by the Corporation from any Municipal Stores and the cost of the same shall be recovered from Contractor's bill, at a rate as measurement in Schedule-``B" the same shall be carted by the Contractor from Municipal Stores to the site of the work at its cost.

After each section of the pipeline has been completed it shall be tested for water tightness. The ends shall be suitably closed with a valve, cap, plug or a blank flange. The pipe

line shall then be filled with water, Pressure shall then be supplied with a hand force pump up to 7 kg/sq.cm. (above 100 lbs/sq. inch) or 15 percent above the highest working pressure in the line whichever is more. When the pipe is laid on an appreciable gradient, the test shall be carried out at the upper end of the section.

Any leaking joints shall be made good and the test repeated until a perfectly leak proof pipe line obtained.

The contractor after one year of defect liability period from date of completion of work. Contractor have to give guarantee of leakage proof lead joint and rubber ring joint. If these joints will leak, contractor have to repair it by his own cost within the defect liability period.

Mode of measurement and payment:

The rate shall be paid on number basis.

### ***Item no.8.14 Making Tyton Rubber Gasket***

#### ***8.14 Making Tyton Rubber Gasket with specials of D.I. Fittings***

***(a) 100 mm Dia.***

***(b) 150 mm Dia.***

***(c) 200 mm Dia.***

***(d) 250 mm Dia.***

***(e) 300 mm Dia.***

***(f) 350 mm Dia.***

***(g) 400 mm Dia.***

***(h) 450 mm Dia.***

***(i) 500 mm Dia.***

***(j) 600 mm Dia.***

***(k) 700 mm Dia.***

***(l) 750 mm Dia.***

Contractor has to provide tools, machinery, labour etc. for joints. SMC will not provide anything.

Mode of measurement and payment:

Payment shall be made as per number of joints.

### ***Item no.8.15 Cutting the C.I/D.I. Pipe***

#### ***8.15 Cutting the C.I/D.I. Pipe in pieces as necessary for fitting the special like Tee,bend etc. complete.***

***(a) Pipe thickness up to 10mm.***

***(b) Pipe thickness 11mm to 20 mm***

***(c) Pipe thickness 21 mm to 33 mm***

Contractor has to cut the pipes for fixing specials, valves etc. as per site condition as and when required.

Contractor has to provide Tools, Machinery etc. for the cutting. The pipe should be cut with due care to have true sharp edge which can chamfered easily. Chamfering shall be done by Contractor. Due to any reasons the pipes are not cut as required, no payment shall be made for the damaged portion, he shall have to again cut the pipe as per the requirement without claiming any extra cost. The pipe shall be cut by using standard cutting machines and material which shall be in accordance to Relevant Indian Standard.

Mode of Measurement and payment:

one running meter of periphery of pipe.

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***Item no.8.16 Chamfering D.I. Pipes***

***8.16 Chamfering D.I. Pipes as necessary for fitting the specials like Tee, Bend etc. complete***

- (a) 100 mm Dia.***
- (b) 150 mm Dia***
- (c) 200 mm Dia.***
- (d) 250 mm Dia.***
- (e) 300 mm Dia.***
- (f) 350 mm Dia.***
- (g) 400 mm Dia.***
- (h) 450 mm Dia.***
- (i) 500 mm Dia.***
- (j) 600 mm Dia.***
- (k) 700 mm Dia.***
- (l) 750 mm Dia.***

Chamfering of C.I./D.I. pipes includes making the end of pipes beveled by using required tools, materials, machineries, labours etc. including rolling grinding or minor cutting etc. complete as required. Ends shall be beveled to an angle of 20 degree with a limit of maximum + 5 degree and no lower limit, to be measured from a line drawn perpendicular to the axis of the pipe. Beveling should exactly conform to the provision of IS 3589-1991 or its latest amendments. During making the end of the pipe beveled, due care must be taken so that the pipes are not damaged/deformed during beveling, the same must be rectified to the satisfaction of Engineer-in-charge. The work shall be carried out through skilled artisans/labour so as to have no wastage of the pipe. However if there is any wastage, the cost of such wastage length of pipe shall be recovered from the Contractor and decision of the Engineer-in-charge in this regard shall be final and binding.

Contractor has to provide tools, machinery, labour etc. for chamfering. SMC will not provide anything.

Mode of measurement and payment:

Payment shall be made as per number of chamfering of pipe.

***Item no.8.17 Making arrangement of flushing work***

***8.17 Making arrangement of flushing work of laid line as directed by the engineer in charge and as per the specification and site condition.***

- (a) Dia of pipe up to 300mm***
- (b) Dia.of pipe from 350 up to 600mm***

The contractor shall have to make arrangement for making flushing of the entire laid pipeline as per the instruction of Engineer-in-charge up to the achievement of desirable quality of water. Necessary labour, tools, machineries and other necessary equipment shall have to arrange by contractor only.

Water required for flushing will be arranged by S.M.C. Water Distribution Station. As S.M.C. will arranged flushing program of laid line in different stages, contractor shall have to first excavate the trenches at the location of dead end or at 'T' Open junction as per the instruction given by Engineer-in-charge. Proper size of trench shall have to excavate at the location so as to take necessary samples of water (i.e. up to 0.3 mt. below the bottom end pipe and at least 1.2 mt. x 1.2 mt. sizes in length and width). Trench shall have excavated end extended up to nearest creek/storm water chamber. Contractor shall have to clamp and plug

the open and pipe. The item also includes necessary valve operation and opening and closing of scour valve and air valve.

Any leakages found shall be repaired by the Contractor at his own cost at the time of flushing. After flushing the dead end/tee open joint shall be capped / plugged by the Contractor at his own risk and cost. No extra lead joint shall be given for this item. Necessary barricading, lighting and necessary safety precaution shall have made by the Contractor. If accidents occur due to lack of above safety provision, the entire responsibility shall be on contractor head.

Mode of Measurement and payment:

The payment shall be made on Numbers of flushed out pipe end basis.

### ***Item no.8.18 Providing and making connection with Existing line***

***8.18 Providing and making connection with Existing line of the following diameter including placing TEE and Collar including cutting the existing line & necessary dewatering. All the arrangement for dewatering (i.e Dewatering pump etc.) shall be provided by the Contractor on site at his own cost. Excavation shall be paid as per Item No.1, Lead Joint for this item shall be paid as per the Item No.8.13***

***(A) 750 mm dia***

***(B) 700 mm dia***

***(C) 600 mm dia***

***(D) 500 mm dia***

***(E) 450 mm dia***

***(F) 400 mm dia***

***(G) 350 mm dia***

***(H) 300 mm dia***

***(I) 250 mm dia***

***(J) 200 mm dia***

***(K) 150 mm dia***

***(L) 100 mm dia***

Mode of measurement and payment:

The rate shall be for a unit of one number.

### ***Item no.8.19 Providing and laying C.C 1:3:6***

***8.19 Providing and laying C.C 1:3:6 (1- cement :3- coarse sand : 6- graded stone aggregate of 40 mm nominal size)and curing , compacting including cost of form work for P.C.C.***

For foundation and plinth and pipe encasing:

Item shall be carried outing general and shall be as per IS 456:1984 or revised from time to time shall be followed.

The materials like cement, sand, coarse aggregates shall be as per the general specification of the materials and as per relevant IS.

Concrete Mix:

In ordinary concrete, the proportion of cement to fine aggregate to coarse aggregates shall be 1:3:6 i.e. one part of cement and three parts of sand and six parts of coarse aggregates. The volume of cement is considered to be 1.20 cft.

The crushing strength of 6 "square cube shall be as per Table No.1, I.S. 456 i.e. for 7 days

105.5 Kg/cm<sup>2</sup>(1500 lbs/Sq.in) and for 28 days 158.2 Kg/Cm<sup>2</sup> (2250 lbs/Sq.in).

Water Contents:

The water contents for an ordinary concrete mix should generally be equal to 27 to 35 liters per bag. Allowance for surface water present in aggregates shall be made when computing the water content.

Form work:

General:

The form work shall conform to shape, lines and dimensions as shown on plan and be so constructed as to remain sufficiently rigid during the placing and compacting of concrete and shall be sufficiently tight to prevent lose of liquid from the concrete. For form work constructions of plywood or steel plates will be used except for small junction and crossing.

Clearing of forms:

All rubbish, chipping shaving and saw dust shall be removed from the interior of forms before the concrete is placed and form work in context with concrete shall be cleaned thoroughly wetted or treated with the approved composition.

Stripping time:

The frame shall be stripped out after expiry of following period.

- (a) Vertical sides of beams and columns, columns footing - 48 Hours
- (b) Bottom of slabs up to 4.6 M.Span. - 7 Days
- (c) Bottom of slabs above 4.6 M.to 6.0 M.Span. - 14 Days
- (d) Removal of props under beam up to 6 M. Span. - 14 Days
- (e) Removal of props under beam above 6 M.Span. - 21 Days

Procedure when removing the form work:

All form work shall be removed without such sock on vibration as would damage the reinforced concrete. The concrete should be sufficiently hardened before the so fits and props are removed proper precautions shall be taken in cold whether.

Centering:

The centering to be provided shall got approved from the Engineer-in-charge. It shall be sufficiently strong to ensure safety of the form work and concrete work before, during and after pouring concrete, watch shall be kept to see the behavior of centering and form work satisfactory during the concreting. Erection shall also be such that it would allow the removal of forms in proper without damaging either concrete for forms to be removed.

The props of centering should be provided in on firm foundations or base of sufficient strength to carry the load without settlement. The props shall be strong durable and not less than 3" dia. If wooden pulling are used. In case of centering of slabs, the props shall be of 3" dia c/c for beams and shall be placed not more than 2 to 2'-3" c/c.

The cross horizontal struts shall be provided at every 8"to 10" height of props. The centering and form work will be inspected and approved by the Engineer- in-charge before concreting. But this will not relieve the contractor or responsibility for strength and safety of the form works and centering. If there is failure of form work or centering, contractor shall be responsible for any damage to work, or injury to life and property.

Scaffolding:

All scaffolding and hoisting arrangements ladders etc., required for the concreting shall be provided and removed, on completion of the work by contractor at his own expense. The scaffolding, hoisting arrangements, ladders etc. shall be strong to withstand all the live, dead, and impact, load, expected to act and shall be subject to approval of the Engineer-in-charge. However the contractor shall be completely responsible for the work and workman etc.

Workmanship:

The quantity of cement shall be assumed to be per bag having volume 1.2 cft. The quantity of fine and coarse aggregates shall be measured in volumetric basis i.e. steel phromes of 0.30 x 0.30 x 0.38 high.

Mixing:

Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and mass is uniform in colour and consistency.

The case of failure of the machinery, hand mixing shall be permitted but in such cases, 10% extra cement shall have to be used without any extra cost to the Corporation.

Transporting:

Concrete shall be handled from the place of mixing to the place of final deposit at rigidly, as practicable by methods which will present the segregation or base any in gradients. During hot or cold weather, concrete shall be transported in deep containers.

Placing and compacting:

Concrete shall be carried out continuously up to construction joints, the position and arrangements shall be determined by the department. When the work has to be resumed on the surface which are hardened such surface shall be roughened on before the new concrete is laid.

Compacting:

Concrete shall be thoroughly compacted during the operation of placing and thoroughly worked around the reinforcement and into corner of form work by means of mechanical vibrator and wooden screeds, so that whole mass becomes compact and homogeneous and there is no air bubble or honey combing. At the time of concreting, proper care shall be taken, so that honey combing formation is minimum.

After the form work is removed, if any such honey combing etc. work is found, it shall be immediately finished with the cement mortar 1:1, so that the crevices are properly filled and no reinforcement is exposed. If however, the honey combing is found of any severe nature and is found throughout the surface of concreting, exposing the reinforcement. The concrete work shall be rejected and redone without any extra cost.

The concrete shall be covered with a layer of stacking canvas hessian or similar absorbent materials and kept constant wet for 20 days from the date of placing of concrete for R.C.C. slab cement or lime mortar cykes 7 c.m. to 10 c.m. height shall be filled with water. If proper curing arrangement is not done by contractor the same shall be done by department at risk and cost of the contractor and the contractor shall be fully responsibility for the same.

Testing:

The work test concrete shall be carried out as per Appendix 'E' of I.S.456. The size of cubes shall be 15 cm x 15 cm x 15 cm. The mould for test specimen shall be made of steel plated. They shall not vary from the std. dimension by more than one percent. The moulds shall be so constructed that there will not be leakage of water from the test specimen during moulding. More samples of concrete consisting six cubes sizes 150 mm x 150mm x 150 mm shall be taken for every 45 cms. or part there of concrete work. The contractor may taken his own arrangement for taking samples and testing of the samples in Government laboratories at his own cost. A register shall be maintained at site of the work.

Results of the test shall be as per requirements as per I.S. If the results are found slightly below the prescribed limit and within permissible range. The work shall be accepted by the Engineerin- charge as a special case if deemed proper otherwise the work shall be rejected.

Finishing:

After removing the centering all exposed R.C.C. members shall be tightly chiseled to have proper key with mortar plastering work and shall be finished with cm 1:3 cement plastered of required thickness of 1/2" to bring the work in line and level including cement finishing etc

Item includes all materials, labours, tools plants and machinery required for the satisfactory completion of item including forms, centering, scaffolding and carrying out necessary test as per I.S. 516:1959 including finishing etc. complete.

Mode of measurement and payment:-

The item shall be measured and paid on cubic meter basis.

The measurements of various member of R.C.C. shall be taken as per respective items and as per the I.S. 120-1958. The payment shall be made as per size of member cast without considering finishing and also exclusive of reinforcement.

***Item no.8.20 Providing and constructing brick work***

***8.20 Providing and constructing brick work using common burnt clay Fly Ash building bricks confirming to IS:13757, IS:5454 ,IS:3495 having crushing strength not less than 50Kg/Sq.cm. brick masonry as per the detailed drawing using brick of approved quality in foundation and plinth incl. racking out joints, watering etc. as directed in CM 1:6 (1 Cement:6 coarse sand)***

**MATERIALS:**

Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-5, Fly ash building bricks shall conform to M-12, Cement mortar shall conform to M-8.

**WORKMANSHIP:**

Proportion: The proportion of cement mortar shall be 1:6 (1 cement, 6 fine sand) by volume. Wetting of Fly ash building bricks : The Fly ash building bricks required for masonry work shall be thoroughly wetted with clean water for about two hours before use or as directed. The cessation of bubbles, when the Fly ash building bricks are wetted with water, is an indication of thorough wetting of Fly ash building bricks.

Laying: Fly-ash building bricks shall be laid in English bond unless directed otherwise. Half or cut Fly-ash building bricks shall not be used except when necessary to complete the bond.

Closures in such case shall be cut to required size and used near the ends of the walls.

A layer of mortar shall be spread on full width for suitable length of the lower course. Each Flyash building bricks shall first be properly bedded and set home by gently tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next Fly-ash building bricks is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.

The walls shall be taken up truly in plumb. All courses shall be truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of Fly-ash building bricks course shall be kept in uniform.

The Fly-ash building bricks shall be laid with frogs up wards. A set of tools comprising of wooden straight edges, mason's spirit level, square half meter rub, and pins, string and plumb shall be kept on the site of work for frequent checking during the progress of work.

Both the faces of walls of thickness greater than 23 cms. Shall be kept in proper place. All the connected Fly-ash building bricks work shall be kept not more than one meter over the rest of the work. Where this is not possible, the work shall braked back according to bond (and not left toothed) at an angle not steeper than 45 degrees. All fixtures, pipes, outlet of water, hold fasts of doors and windows etc. which are required to be built in wall shall be embedded in cement mortar.

Joints: Fly-ash building bricks shall be so laid that all joints are quite flush with mortar.

Thickness of joints shall not exposed 12 mm. The face joints shall be raked out as directed by raking tool daily during the progress of work, when the mortar is still green so as to provide key for plaster or pointing to done.

The face of Fly-ash building bricks shall be cleaned the very day on which the Fly-ash Building brick work is laid and all mortar dropping removed.

Curing : Green work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for a period of seven days. The top of masonry work shall be kept well wetted at the close of the day.

Preparation of Foundation Bed: If the foundation is to be laid, directly on the excavated bed, the bed shall be leveled, cleared of all loose materials, cleaned and wetted before starting masonry.

If masonry is to be laid on concrete footing the top of concrete shall be cleaned and moistened. The contractor shall obtain the engineer's approval for the foundation bed, before foundation masonry is started. When pucca flooring is to be provided flush with the top to plinth, the inside plinth offset shall be kept lower than the outside plinth top by the thickness of the flooring.

Fixtures - The frames of doors, windows, cup-boards etc. shall be housed into the Fly-ash building bricks work at the correct location and level as directed. The heavy steel doors, window frames etc. shall be built in with Fly-ash building bricks work, but for ordinary steel doors and windows required opening for frames, hold-fasts etc. shall be left in the wall and frames embedded later on in order to avoid damage to the frames.

Scaffolding - Necessary scaffolding shall be provided. The supports of the scaffolding shall be sound and strong tied together with horizontal pieces, over which the scaffolding plunks shall be fixed. Simple scaffolding shall be allowed normally. In this case scaffolding hole shall rest in hole header horizontal course only. Minimum number of holes shall be left in Fly-ash building bricks work for supporting horizontal scaffolding poles. The contractor is responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

Packing out of Joints - For the face of Fly-ash building bricks work, where plastering is to be done, joints shall be raked out to a depth not less than thickness of joints. The face of Fly-ash building bricks work shall be cleaned and mortar dropping removed on very same day that Flyash building bricks work is laid.

Mode of measurement and payment:-

The measurements of this item shall be taken in cubic meter and for the Fly-ash building bricks masonry fully completed for limiting dimensions not exceeding those shown on the plans or as directed shall be final.

No deductions shall be made from quantity of Fly-ash building bricks work. No extra payment will be made for embedding in masonry holes in respect of the following items -

- i] Ends of joints, beams, posts, girders, rafters, purlins, trusses, corbel, steps etc. Where cross sectional area does not exceed 500 Sq.Cm.
- ii] Opening not exceeding 1000 Sq.Cm.
- iii] Wall plate sand bed plates, bearing of slab, chajjas, and like whose thickness does not exceed 10 Cms. and the bearing does not extend the full thickness of wall.
- iv] Drainage holes and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.
- v] Iron fixtures; pipes up to 300 mm. dia. hold fasts of doors and windows built into masonry and pipes etc. for concealed wiring.
- vi] Forming charges of section not exceeding 350 Sq.Cm. in masonry.
- vii] Apertures for fire places shall not be deducted nor shall extra labour required to make splaying of jambs, throating and making arches over the aperture be paid for separately.

The rate shall be for a unit of one cubic meters.

### ***Item no.8.21 Providing and applying 10 mm thick cement plaster***

***8.21 Providing and applying 10 mm thick cement plaster in single coat on brick / concrete walls similar surface for plastering and finished even and smooth with a floating coat of neat cement slurry mixed with admixture of lime required proportion etc. complete in C.M. 1:3 (1 cement : 3 sand) as directed by the Engineer-in-charge.(As per R&B SOR 2011-12, Page No11, 12, Ch-17, I.No. 1-17.58 & 4-17.69)***

**MATERIALS:**

Water shall conform to M-1. The cement mortar of proportion 1:3 shall conform to M-8.

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**WORKMANSHIP:**

Scaffolding -Wooden ballies, bamboos, planks, treatlesand other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls. Preparation of Background - The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface be roughened by wire brushing if it is not hard and hacking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface. Raking of joints in case of masonry work where necessary, shall be allowed to dry out for sufficient period before carrying out the plaster work.

The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such areas shall be moistened again.

For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

**APPLICATION OF PLASTER**

The plaster about 15 x 15 Cms. shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surface gauges shall be truly in place of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel of wooden flat according as a smooth or a sandy granular texture is required. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished Rounding or chamfering, corners, junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed forthwith from the site. In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically. When recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together.

Plastering work shall be closed at the end of the day on the body of the wall and nearer that 15 cms. to any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal points in plaster work shall not also occur on parapet tops and copings as those invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

Each coat shall be kept damp continuously till the next coat is applied for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking or walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air to dry weather shall be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

Mode of measurement and payment:-

The rate shall include the cost of all materials, labour and scaffolding etc. involved in the operations described under workmanship.

All plastering shall be measured in square meters unless otherwise specified. Length, breadth or height shall be measured correct to a centimeter.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves or open joints in brick work, stone work etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm. at any point on this surface.

This item includes plastering at any level.

For jambs, soffits, sills etc. for openings not are exceeding 0.5 Sq.Mts. each in area for ends of joints, beams, posts, girders, step etc. not exceeding 0.5 Sq.Mts. each in area and for openings exceeding 0.5 Sq.Mts. and not exceeding 3 Sq.Mts. in each area deductions and additions shall be made in the following manner.

a) No deductions shall be made for ends of joints, beams, posts etc. and openings not exceeding 0.5 Sq.Mts. each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings for finish to plaster around ends of joints, beams, posts etc.

b) Deduction for openings exceeding 0.5 Sq. Mt. but not exceeding 3 Sq.Mt. each shall be made as follows and no additions shall be made for reveals, jambs, soffits sills etc. of these openings.

i) When both faces of all walls are plastered with same plaster, deduction shall be made for one face only.

ii) When two faces of wall are plastered with different types of plaster or if one face is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from areas of plaster and/or pointing as the case may be.

The rate shall be for a unit of one Sq.Mts.

### ***Item no.8.22 Providing and laying M-20 nominal mix concrete***

***8.22 Providing and laying M-20 nominal mix concrete (I.e in prporation of CM 1:1-1/2:3 (1- cement : 1-1/2 -fine Agg.and 3- 20 mm nominal size kapachi) including cost of form work but excluding cost of reinforcement including curing etc. complete.***

Materials:-

Water shall conform to M-1, Cement shall conform to M-3. Sand shall conform to M-5. Grit shall conform to M-6. Graded stone aggregate 20 mm nominal size shall conform to M-9.

General:-

The concrete mix is not required to designed by preliminary tests. The proportion of the concrete mix shall be 1:1 1/2:3 [1 cement:1 1/2 coarse sand:3 graded stone aggregate 20 mm nominal size] by volume Concrete work shall have exposed concrete surface or as specified the item.

The designation ordinary M-100, M-150, M-200, M-250 specified as per I.S. corresponding approximately to 1:3:6 1:2:4, 1:1:1, 1:1 1/2: 3 and 1:1:2 nominal mix of ordinary concrete by volume respectively with conforming to IS:456.

The ingredients required for ordinary work, containing one bag of cement of 50 kg. by weight [0.0342 cu.m.] for different proportion of mix shall be as under.

Grade of concrete	Total quantity of dry aggregate by volume per 50 kg. of cement to be taken as the sum of individual	Proportion of line aggregate to coarse aggregate	Quantity of water per 50 kg.of cement maximum

	volume of fine and coarse aggregate maximum		
M-100 [1:3:6]	300 litres	Generally 1:2 for fine aggregate to	34 litres
M-150 [1:2:4]	220 "	Coarse aggregate by volume but subject	32 "
M-200 [1:1.5:3]	160 "	to and upper limit of 1:1 1/2 & lower	30 "
M-250 [1:1:2]	100 "	limit 1:3	27 "

The water cement ratios shall not be more than those specified in the table. The cement content of the mix specified in the table shall be increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction so that the water cement ratio specified in the table is not exceeded.

Workability of the concrete shall be controlled by maintaining a water cement ratio that is found to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty with the means available.

The maximum size of coarse aggregate shall be as large as possible within the limits specified but in no case greater than one fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

For reinforced concrete work, coarse aggregates having a nominal size of 20 mm generally considered satisfactory.

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

Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important and the nominal maximum size may sometimes be as greater than the minimum cover.

Admixture may be used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time; neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures.

#### WORKMANSHIP:

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

In case of beam and slab construction, sufficient number of precast cover blocks in cement mortar 1:2 [ 1 cement 2 coarse sand ] about 4 x 4 cms. section of thickness equal to the specified cover shall be placed between the bars and shuttering as to secure and maintain the requisite cover of concrete over the reinforcement.

In case or cantilevered or doubly reinforced beams or slabs, the main reinforcing bars shall be held in position by introducing cabin spacers or supports bars at 1.0 to 1.2 meters centers.

In case of columns and wall, the vertical bars shall be kept in position by means of timber template with slots accurately cut in them, the templates shall be removed after concreting has been done below it. The bars may also be suitably tied by means of annealed steel wires to the shuttering to maintain their position during concreting.

All bars projecting from pillars, columns, beams, slabs etc. to which other bars and concrete are to be attached or bounded to later on, shall be protected with a coat of thin neat cement grout, if the bars are not likely to be incorporated with succeeding mass of concrete

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within the following 10 days. This coat of thin neat cement shall be removed before concreting.

Proportioning:-

Proportioning shall be done by volume, except cement which shall be measured in terms of bags of 50 kg. Weight. The volume of one such bag being taken as 0.0342 cu. meters. Boxes of suitable sizes shall be used for measuring sand and aggregate. The size of the boxes [internal] shall be 35x25 cms. and 40 cms. deep. While measuring the aggregate and sand, the boxes shall be filled without shaking, ramming or hammering.

The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulking shall be made.

Mixing :-

For all work, 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. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After about half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shown complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than two minutes after all ingredients have been put into the mixer.

When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Specified quantity of water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing, quantity of cement shall be increased by 10 percent above that specified.

Mixer which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch, unless otherwise agreed to by the Engineer-in-charge. The first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement concrete to another.

Consistency :

The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump test in accordance with I.S. 1199 : 1959. The slump of 10 mm to 25 mm shall be adopted when vibrators are used and 80 mm when vibrators are not used.

Inspection :

Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men, machinery, materials and for results obtained. Immediately before concreting, all forms shall be thoroughly cleaned.

Centring design and its erection shall be got approved from the Engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile platform shall be provided so that steel

reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose.

Transporting and laying :-

The method of transporting and placing concrete shall as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place.

All form work shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of structure until the approval of Engineer-in-charge.

Concreting shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meters when internal vibrators are used and not exceeding 0.30 meters in all other cases. Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters.

When trunking or chutes are used they shall be kept close and used in such a way as to avoid segregation. 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, this 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where 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 layers 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.

All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer - in - charge for exceptional cases such as concreting under water where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns.

Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. Within 30 minutes of addition of water to dry mixture during compaction. It shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

Curing:-

Immediately after compaction, concrete, weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process it shall be covered with wet sacking, hessian or other similar absorbent material approved, soon after the initial set and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

Sampling and Testing of concrete :-

Samples from fresh concrete shall be taken as per IS 1199:1959 and cubes shall be made, cured and tested at 7 days and 28 days as per requirements in accordance with IS 516:1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the

entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following.

Quantity of concrete in the work	No. of samples
1-5 Cmt.	1
6-15 Cmt.	2
16-30 Cmt.	3
31-50 Cmt.	4
51-and above sample for each additional 50 cmt. or part thereof.	4+one additional

Note:- At least one sample shall be taken from shift. The test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of the concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

The average strength of the group of cubes cast for each day shall not be less than the specified cube strength of 150 kg/cm<sup>2</sup> at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportion given for a particular grade does not yield the specified strength such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the proportions given for a particular grade shall not, however, be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

#### Stripping:

The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time for removal of form work, due consideration shall be given to local conditions, character of the structure, the weather & other conditions that influence the setting of concrete and of the materials used in the mix. In normal circumstances [generally where temperatures are above 20°C] and where ordinary concrete is used forms may be struck after expiry of period specified in the Item No.4 for respective item of form work.

All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soffits are removed, the concrete surface shall be exposed, where necessary in order to ascertain that the concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. Cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

Immediately after the removal of forms all exposed bolts etc. Passing through the cement member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. below the surface of the concrete and, the resulting hole be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depression, honeycomb spots, broken edges or corner and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and so as dry consistency

as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all avoids. Surfaces which are pointed shall be kept moist for a period of 24 hours.

If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare portions of the structure affected. Mode of measurement and payment:

The consolidated cubical contents of concrete work as specified in item shall be measured. The concrete laid in excess of section shown on drawings or as directed shall not be measured. No deductions shall be made for.

[a] Ends of dissimilar materials such as joints, beams, posts, girders, rafters, purline, trusses, corbels and steps etc. up to 500 sq.cm. in section.

[b] Opening up to 0.1 sq.m.

[c] The volume occupied by reinforcement shall not be deducted from R.C.C. work.

The rate includes cost of all materials labour, tools and plant required for mixing, placing in position vibrating and compacting, finishing as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate excludes the cost of form work.

The rate shall be for a unit of one cubic meters.

### ***Item no.8.23 Providing, Cleaning straightening, Cutting, bending binding***

***8.23 Providing, Cleaning straightening, Cutting, bending binding in position TMT bar for Reinforced concrete work conforming to IS 1786 and Mild steel reinforcement conforming to IS 226.***

MATERIALS:

Mild steel bars shall conform to M-14 TMT bar shall conform to M-15, Mild steel binding wires shall conform to M-17.

WORKMANSHIP

The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed.

Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting.

Reinforcing steel shall conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings.

Bars shall be bent cold to specified shape and dimensions or as directed, using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material.

Bars bent during transportation or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified for mild steel a "U" type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of the circle having an equivalent effective area.

The hooks shall be suitably encased to prevent any splitting of the concrete. The cold twisted steel bars shall be used without hooks at the ends. Deformed bars without hooks shall, however, comply with relevant anchorage requirements.

All the reinforcement bars shall be accurately placed in exactly the same position as shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm. in size, and by using stay blocks or metal chair

spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of the concrete, except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, pre-cast mortar blocks or other approved devices.

Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All the bars are to be spliced and which are likely to be exceeding 10 days shall be protected by a thick coat of neat cement grout. Bars crossing each other where required shall be secured by binding wires (annealed) of size not less than 1 mm. in such a manner that they do not slip over each other at the time of fixing and concreting.

As far as possible, bars of full length shall be used, in case this is not possible, overlapping of bars shall be done as directed. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm. or 1.25 times the maximum size of the coarse aggregate whichever is greater between them. Where not feasible, overlapping bars shall be bound with annealed wires, not less than 1 mm. thick twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither shear nor bending moment is maximum.

Wherever indicated on the drawings or desired by the Engineer-in-charge bars shall be joined by couplings which shall have a cross section sufficient to transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standard threads. Steel for coupling shall conform to I.S-226.

When permitted or specified on the drawings, joints of reinforcement bars shall butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subjected to more than 75% of the maximum permissible stresses and welds so staggered that at any one section not more than 20% of the rods are welded. Only electric welding using a process which excludes air from molten and conforms to any or all other special provisions for the work shall be accepted.

Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

Mode of measurement and payment:-

For the purpose of calculating consumption, wastage shall not be permitted beyond 7.5%. Excess consumption over 7.5% will be charged at penal rate as per special condition of contract.

Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to, in place of lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the same basis of as per M-14 even though steel is supplied to the contractor by the department on actual weight. Length shall include hooks at the ends.

Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

The rate for reinforcement includes cost of steel binding wires, its transporting from departmental store to work site cutting, bending, placing and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage.

The rate shall be for unit of one Kg.

Note: -Read M.S. Binding wire instead of G.I. binding wire when and where specified.

### ***Item no.8.24 Providing and fixing C.I \PVC steps***

***8.24 Providing and fixing C.I \PVC steps of size 300 x 150 x 25 mm in the masonry chamber. The steps shall be fixed at the time of constructing the chamber.***

During the construction of masonry wall of the manhole the cement mortar of required proportion shall be used for embedding the Poly-propylene steps in the wall masonry. The spacing of steps in the masonry shall be 300 mm center to center in the staggered position in the vertical direction with two staggered rows at 385 mm center to center in the horizontal direction the top of the manhole shall not be more than 300 mm above the benching and the center line of two staggered rows shall be the center line of the shorter side of manhole frame in the roof of chamber.

The detailed specifications for the "Poly propylene steps as below:

The Polypropylene conforming to an ASTM D-4101, injection molded around a 12 mm dia. IS 1786 grade Fe-415 steel reinforcing bar and should meet the load required 225 Kg. as per IS- 5455. The measurement should be as per attached drawing. The tolerance in the length and width is +/- 5 mm and +/- 1 mm in thickness. The weight of the steps should not be less than 0.900 Kg.

Un-chequered portion of the step shall be inserted with the risk cement mortar during the course of masonry work so constructed around the steps as to keep the step on its right position. The non-slip grape chequered portion of the steps shall be well kept outside the masonry.

During fixing of the steps, they shall not be damaged and shall not vibrate or shall not shake during ascents and descents otherwise they shall have to be re fixed correctly as per the drawings or as mentioned above.

Providing and fixing C.I.Steps:

C.I. steps of 300 x 150 x 25 mm size shall be of best quality.

Painting material for anti-corrosive shall be of best quality.

C.I. Steps shall be fixed as and where directed. The steps shall be embedded firmly in masonry wall and fixing in horizontal space between two steps shall will be as directed by the Engineer-in-charge.

The rate includes cost of all labours and materials required for completion of this item.

Mode of measurement and payment:

The rate shall be for a unit of one number.

### ***Item no.8.25 Providing & fabricating the clamping arrangement for caps,plugs***

***8.25 Providing & fabricating the clamping arrangement for caps,plugs at the open end of the pipe line inclg. necessary excavation dewatering if any,welding fabrication ,nuts ,bolts etc comp. as per the direction of engineer in charge.***

The item includes the clamping arrangement for caps and plugs at the open end of the pipes by using required tool, materials, machinery, labour etc. complete as required. Item also

includes necessary excavations. Dewatering if any, for the proper working. The clamping shall be such that the cap or plug shall not skip out by water pressure. The work shall be carried out through skilled labour. Any wastage occur shall be borne by the Contractor.

The quantity shown in the tender is very approximate and the work shall have to be carried out at the quoted rates for the quantity to be executed in accordance with the exigency/requirement during the progress of the work.

Mode of measurement:-

Payment shall be made on per kg. of the clamping arrangement.

### ***Item no.8.26 Providing & laying 1:2:4 C.C***

#### ***8.26 Providing & laying 1:2:4 C.C for the thrust block inclg. cost of form work.***

(A) For Rectangular manhole of I.S.I. Mark

Outer dimension of frame :- 900 mm x 750 mm

Thickness :- 175 mm

Protection for edge :- as per drawing

Clear Opening :- 600 mm x 450 mm

Tolerance :- +/- 5 mm.

Heavy duty Cover (rectangular) :-

Outer dimension :- 750 mm x 600 mm

Thickness :- 100 mm

Lifting hooks :- 16 mm Tot Bar welded to the bottom with steel. It shall be easily and quickly opened with crow bars and pickaxes.

Protection for edge :- Same as for frame.

Design Load and carrying capacity: 35 M.T.

Tolerance :- +/- 5 mm

NOTES:-

(i) Cover shall confirm I.S. 12592 (Part-I 1988.)

(ii) Frame shall confirm I.S. 12592 (Part-II 1991)

(iii) After production of each lot of manhole frame and cover the contractor shall send the offer letter for testing of same to Hydraulic Engineer. The authorized representative of Hydraulic Engineer shall select the specimens of cover as per I.S. for the load test, which should be carried out at S.V.N.I.T. Surat. The specimens of frame should be checked for its reinforcement which must be provided as per detailed drawings attached with tender. The cost for testing of manhole cover and frame broken for inspection shall be born by the contractor in any case.

Mode of measurement and payment:

The rate shall be for unit of one Number.

### ***Item no.8.27 Providing & fixing R.C.C.Precast Manhole Frame with cover***

***8.27 Providing & fixing R.C.C.Precast Manhole Frame with cover in M-350 as per drawing for Manhole suitable for 450x600 cm opening of M.H. including cost of reinforcement M.S. Angles or Flate, curring mold work etc.complete.***

***(a) Heavy Duty***

### ***Item no.8.28 Providing and fixing M.S manhole frame and cover***

***8.28 Providing and fixing M.S manhole frame and cover of required size including necessary hold fast arrangement. The frame shall be grouted in the RCC slab at the time of casting the slab including one coat of primer and two coat of oil paint. The frame shall be of M.S. angle of size 65X65X6 mm & 12 mm thick M.S. plate as directed by Engineer-in-charge.***

Mode of measurement and payment:

The rate shall be for unit of one Kg.

***Item no.8.29 Bailing out subsoil or drainage water***

***8.29 Bailing out subsoil or drainage water by pumps as directed after excavation and during concreting / pipe laying work and keeping dry the area till the complete of work as per information given by the Engineer-in-charge.***

Dewatering by pumping set of required capacity including temporary platform carting pumping at site and fixing the same in position including all accessories and fuel and labour etc. complete.

(Note: - This item shall only be executed when bailing out of drainage/ subsoil water is more than 5 HP.hour).

For dewatering of drainage water from storm line and subsoil water if any shall be diverted with the help of necessary tools, bibs, plants, equipments, diesel pump, fuel etc. All the equipments required for dewatering shall be provided operated and maintained by the contractor himself. The necessary suction and delivery pipe shall be of sufficient length to divert the sewage/subsoil water from the trenches.

The Contractor must repair the leakage joints of storm/private drainage as early as possible as per instruction of Engineer-in-charge.

The rate includes all the tools, plants, machineries, pipes, labour, fuel etc. require for satisfactory completion of this item.

Mode of measurement and payment:

Payment shall be as per the H.P./Hour of pump so run.

***Item no.8.30 Providing D.I./ D.P.***

***8.30 Providing D.I./ D.P. So. and Sp. Pipes & Specials of L.A. Class with or without cement lining.***

***(a) 100 mm Dia.***

***(b) 150 mm Dia.***

***(c) 200 mm Dia.***

***(d) 250 mm Dia.***

***(e) 300 mm Dia.***

***(f) 350 mm Dia.***

***(g) 400 mm Dia.***

***(h) 450 mm Dia.***

***(i) 500 mm Dia.***

***(j) 600 mm Dia.***

***(k) 700 mm Dia.***

***(l) 750 mm Dia.***

Material:

The material in general shall be conforming to IS:1387:1993.

Method for Brinell Hardness test of material shall conform to IS:1500:1983.

Sampling criteria for the various tests, unless specified in this specification shall be as laid down in IS 11606:1986.

Pipe shall be suitable for push on joint rings conforming to IS:5382:1985 and IS:12820:1989.

EPDM (Ethylene Propylene Diene Monomer) rubber gasket shall conforming to IS:5382:1985 with ISI mark.

Manufacture :

The metal used for the manufacture of pipe shall conform to the appropriate as grade specified in IS 8329:2000. It shall be prepared at the discretion of the manufacture in a cupola, an active mixer or other suitable furnace or any other suitable standard method.

The pipes shall be stripped with all precautions to avoid warping shrinkage defects, detrimental to their good quality. The pipes showing shall be sound and free from surface or the defects. Pipes showing shall imperfections which result from the method of manufacture and which do not affect their serviceability shall not be rejected on that account alone. Minor defects arising out of manufacturing process may be rectified with the consent of the purchaser.

The pipes shall be such that they could be cut, drilled or machined. In case of dispute the pipes may be accepted provided hardness measured on the external unmachined surface does not exceed 230 HBS.

Pipes centrifugally cast shall be heat treated in order to achieve the necessary mechanical properties and to relieve casting stresses; accordance with IS:13655:1993.

If necessary, the pipes may be subjected to reheat treatment to ensure that Brinell hardness does not exceed the specified value.

In case of push-on joint, the spigot ends shall be suitably chamfered for smooth entry of pipes in the socket fitted with the rubber gasket. Socket and Spigot dimensions including chamfer must be checked and a test certificate to the effect shall be submitted for each and every pipe without which payment will be released for the same.

The socket dimensions shall be perfectly suitable for Rubber Gaskets conforming to IS 12820:1989. The socket and spigot dimensions including chamfer shall be strictly as per Table-2 of IS:8329:1994.

Sampling:

Sampling criteria for the various tests, unless specified shall be as laid down in IS 11606:1986.

Mechanical Test:

Mechanical tests shall be carried out during manufacture. One tests shall be conducted for every batch of production. Total no. of pipes for each batch would be as per Clause 10.1 of IS 8329:2000.

Ring Test and Tensile Test :

Two test pieces obtained by cutting rings or bars from the spigot end of two pipes selected for testing except for pipes manufactured under controlled cooled process described in 10.1.1 when tested in accordance with the methods specified in IS: 8329 shall satisfy the requirements mentioned in it.

Brinell Hardness Test :

When tested in accordance with IS:1500:1993, the Brinell Hardness shall not exceed 230 HB on the external unmachined surface.

Retest :

If any piece representing a lot fails in the first instance two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the results satisfy the specified requirement, the lot shall be accepted. Should either of these additional test pieces fail, the lot shall be deemed as not complying with IS: 1536:1989 and shall be liable for rejection.

In the event of lot not found conforming to this standard, the same may be reoffered for inspection after reheat treatment.

Hydrostatic Test :

All Pipes shall be tested hydrostatically at the pressure specified in Table 1 of IS 8329:2000 as appropriate. To perform the test, the pressure shall be applied internally and shall be steadily maintained for a period of minimum 10 seconds during which pipes may be struck moderately with a 700 g hammer. The pipes shall withstand the pressure test and shall not

show any sign of leakage, sweating or other defects. As far as possible the hydrostatic test shall be conducted before coating the lining of pipes.

Works Test Requirements :

Socket and spigot pipes shall withstand hydrostatic test pressure as specified in relevant IS codes. 40

Sizes and mass :

The range of nominal diameter, DN, of pipes and flanges is as follows:

100, 150, 200, 250, 300, 400, 450, 500, 600, 700, 750 and 800 mm or as specified in Schedule-'B' NOTE :

Nominal diameter is a number used to classify pipes and corresponds approximately to their clear internal diameter.

Working lengths 'L' of socket and spigot pipes.

(a) Socket and Spigot Pipes: 5.5 and 6.0 m. NOTE:

Approximately 90% of the ordered quantity of pipes ranging from 100 mm dia and above shall be of 5.5 mts Dimensions and mass of uncoated socket and barrel of the pipes shall conform to IS:8329.

Mass for sockets and pipes barrels as specified in IS 8329 shall have density of Cast as 7050 Kg/Mt<sup>3</sup>.

Tolerance :

Tolerance in Diameter :

The tolerance of external diameter of Barrel for all type of pipes unless specified shall be as per Table-7 of Clause 15.1.1 of IS:8329:2000.

For requirement of interchangeability all pipes should be within the tolerance specified. Push- On flexible joints may need closer tolerance for its effective performance.

Tolerance on Ovality:

Pipes shall be as far as possible circular internally and externally. The tolerance for out of roundness of the socket and spigot ends in the jointing zone for Push-on joint are given in Table below:

In case of oval spigot ends for push-on joints (DE), the minor axis is permitted to be less than the minimum allowable diameter by the value given below provided the mean diameter DE measured by circumferential tape, comes within the minimum allowable dimensions of DE (Table-2) after applying the tolerance:

Table Allowable Ovality for Push-on Joint Pipes

Nominal Diameter DN mm	Allowable Difference Between Minor Axis and DE min mm
1	2
80 to 300	1.0
350 to 600	1.75
700	2.0
750 to 800	2.4

Tolerance on Thickness

The tolerance on the wall thickness 'e' and of pipes shall be as follows :

Dimensions	Tolerance in mm
Wall thickness	- (1.3 + 0.001 DN)
*. No limit for the plus tolerance is specified.	

## Tolerance on length

The tolerance on length of pipes shall be as follows :

Type of Casting	Tolerance in mm
Socket and spigot end	+ 100

## Permissible Deviation from a Straight Line :

The pipes shall be straight. When rolled along two gentries separated by approximately two-thirds the length of the pipe to be checked, the maximum deviation from a straight line in mm shall not be greater than 1.25 times the length 'L, in meters of the pipe, thus:

$$f_m < 1.25L$$

Where  $f_m$  = maximum deviation from straight line, and

L = length of the pipe.

## Tolerance on Mass

The permissible tolerance on standard mass of pipe shall be +8 percent for sizes up to and including 200 DN and + 5 percent for sizes above 200 DN

The pipes of heavier mass than the maximum shall be accepted provided they comply in every other respect with the requirements of the specifications.

Coating : Pipe shall be supplied with internal and external coating.

## External protection:-

Each pipe shall be coated externally with metallic zinc coating with finishing layer as mentioned in Annexure- A of IS:8329-2000.

Coating shall not be applied to any pipe unless their surface is clean, dry and free from rust.

The pipes shall be coated by spraying process in which metallic zinc material is heated to a molten state and projected in small droplets.

The coating material shall set rapidly with good adherence and shall not scale off.

The metallic zinc coating shall cover the outside diameter of the pipe end and shall be free from such defects as bare patches or lack of adhesion.

Damaged area of zinc coating caused by handling are acceptable provided that the damaged is less than 5 cm<sup>2</sup>/m<sup>2</sup> of coated surface and provided that the minor dimensions of the damaged area do not exceed 5 mm.

The average mass of zinc coating shall be not less than 130 g/m<sup>2</sup> with a local minimum of 110 g/m<sup>2</sup>.

## Internal Coating:

When the pipes are to be used for conveying sewage water the inside coating shall not contain any constituent soluble in such water or any ingredients which could impart any taste or whatsoever to the sewage water and suitable washing of the mains.

All the pipes must be supplied with internal cement mortar of Ordinary Portland Cement lining strictly conforming to provision of IS:8329:2000.

Cement used for centrifugal lining must be of the best brand available conforming to relevant Indian Standard.

The sand used for preparation of mortar shall have controlled granulometric distribution from fine to coarser elements, it shall be clean and free from dust, clay or any kind of impurities.

The water used for preparation of the mortar shall not contain substances deleterious to the mortar nor to the water as it is eventually intended to transport in the pipe.

The mortar of the lining shall be composed of cement, sand and water.

The mortar shall be thoroughly mixed and shall have a consistency which results in dense and homogeneous lining.

Condition of the interior surface of the pipe before application of the lining.

All foreign bodies, loose scale of any other material which could be detrimental to good contact between the metal and the lining shall be removed from the surface which the lining is to be applied.

The inner surface of the pipe shall also be free of any metal projections likely to project beyond 50% the thickness of the lining.

Application of the lining.

The mortar of the lining is cast centrifugally inside the pipes.

Apart from the inner surface of the joint, the parts of the pipe coming into contact with transported water shall be entirely covered with mortar.

The mortar shall be free of any cavities or visible air bubbles, and care shall be taken to ensure maximum density at all points. The centrifuging the pipe shall be controlled so that segregation of the sand in the lining is reduced to a minimum.

Once centrifuging is finished, the lining shall be cured at temperatures greater than 0 degree

C. Any loss of water from the mortar by evaporation shall be sufficiently slow that hardening is not impeded.

Repairs to damaged or defective areas are allowable. The damaged mortar shall first be removed from these areas. The defective part shall be repaired by using, for example, a trowel within fresh mortar so that a continuous lining having a constant thickness is again obtained.

For the repair operation, the mortar shall have a suitable consistence. If necessary, additives may be included to obtain good adhesion against the side of the existing under-aged mortar.

Thickness of the lining.

The normal thickness of the lining and the minimum permissible mean and local values are given in the table.

At the pipe ends, the lining may be reduced to values below the minimum thickness. The length of the chamfer shall be as small as possible but. In any case, shall be less than 50 mm.

Determination of lining thickness

The thickness of the lining will be checked on the freshly centrifuged mortar by the insertion of a steel pin, or on the hardened mortar by means of a non-destructive method of measurement.

The thickness of the lining shall be measured at both ends of the pipe in at least one section perpendicular to the pipe axis.

In each, section, which shall be at least 200 mm from the pipe 0 end measurements shall be taken at four points spaced at 90

The values for the thickness of the lining shall be reported to the nearer 0.1 mm.

The lining thickness measured at any one point in the pipe shall not be smaller than the minimum value given in the table.

The arithmetic means of the four measurements in each section shall not be less than the minimum mean value specified in the IS:8329:2000.

Surface condition of the hardened lining

The surface of the cement mortar lining shall be uniformly smooth. Only isolated grains of sand are allowed to appear on the surface of the lining.

The lining shall not be friable and shall be free from corrugations or ridges that could reduce the thickness of the lining to less than the minimum value at one point, as specified in the table.

On contraction of the lining, the formation of cracks cannot be avoided. These cracks, together with other isolated crack which may result from manufacture or any develop during transportation, are acceptance up to a width of 0.8 mm.

The structure of the lining is related to the centrifuging process.

On the inner surface of the lining, a thin layer of fine sand and cement is formed which may extend up to approximately one quarter of the total thickness of the mortar.

Thickness of the lining

The thickness of the lining shall be inspected on at least one pipe per section and per centrifuging installation, for each diameter manufactured, which is as per Table-15, Clause B- 5 of IS 8329:2000.

Appearance of the lining

Each pipe shall be inspected for the appearance of the lining with special reference to the surface condition and the finish of the ends.

Any repairs considered to necessary after this examination shall be carried out in accordance with the method described in Clause B-4 of IS:8329:2000

All dimensions are in millimeters

Table-Thickness of the cement mortar lining

DN	Thickness		Maximum Crack Width/Radial Displacement
	Nominal Value	Tolerance	
1	2	3	4
80 to 300	3.0	-1.5	0/8
350 to 600	5.0	-2.0	1/0
700 to 1200	6.0	-2.5	1/2
1400 to 2000	9.0	-3.0	1/5

NOTE:- Fittings ends may have a chamfer of maximum length 50 mm.

Each pipe shall have cast, stamped or indelibly painted on it the following appropriate marks:

- (a) Manufacturer's name, initials or identification mark;
- (b) The nominal diameter;
- (c) Class reference;
- (d) Mass of pipe;
- (e) The last two digits of the year of manufacture.
- (f) Name of the purchaser: SMC.
- (g) ISI Certification Mark.

Marking may be done On the socket faces of pipe centrifugally cast in metal mould.

MODE OF MEASUREMENTS AND PAYMENTS :

The rate for this item includes the cost of all the materials like all the jointing material like rubber gasket for making joints.

The rubber gasket joints shall be done only at the joints with specials and fittings. The item includes the rubber gasket for making joints.

The rate shall include all the charges like loading, stacking, handling, laying, jointing and hydraulic testing.

The rates shall be quoted for all the materials and labour necessary for completion of this item except the cost of D.I. fittings specials and valves. Any variation in cost of necessary materials due to any reason shall not at all be accepted i.e. price variation due to any reasons will not be accepted.

The measurement shall be paid per meter length of pipe line laid, jointed, tested and measured along the centre line and shall be paid according to the inner diameter of the pipes at the rates quoted by the contractor in price- bid.

### ***Item no.8.31 Providing D.I. Double Flange Sluice Valve***

***8.31 Providing D.I. Double Flange Sluice Valve with the sets of tail pieces of approved Quality.***

***(a) 100 mm Dia S.V.***

- (b) 150 mm Dia. S.V.**
- (c) 200 mm Dia. S.V.**
- (d) 250 mm Dia. S.V.**
- (e) 300 mm Dia. S.V.**
- (f) 350 mm Dia. S.V.**
- (g) 400 mm Dia. S.V.**
- (h) 450 mm Dia. S.V.**
- (i) 500 mm Dia. S.V.**

The contractor shall have to procure required ductile iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs, tail pieces, etc. necessary for completion of this item as per site conditions.

The D.I. fittings and specials shall conform to BS-EN 545/1995 class-A series K12 suitable for IS: 8329/1994 with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drilled or machined.

The mass of D. I .Fittings / Specials shall be strictly confirm to IS: 8329/1994 with latest amendments shall have density of Cast as 7050 Kg/mt<sup>3</sup>.

The rates shall be inclusive of all the taxes, duties, loading, unloading, inspection and testing charges, octroi etc. comp. The rates shall be for free delivery at site.

The contractor shall have to procure the required D.I. fittings or specials as per the site conditions and as per direction of Engineer-in-Charge. Excess or Damaged or Broken D.I. fittings/specials shall be removed by the contractor at his own cost and such D.I. fittings/specials will not at all be admitted for its payments.

#### MODE OF MEASURMENT & PAYMENT FOR:

The payment shall be on the basis of per Kilogram of the D.I. fittings/ specials used for completion of this work. The standard weight prescribed under IS code with latest amendments shall only be considered for payment.

### ***Item no.8.32 Providing D.I. Fittings***

#### ***8.32 Providing D.I. Fittings***

##### ***A/S TEE***

***100x100x100 mm dia***

***150x150x100 mm dia***

***150x150x150 mm dia***

***200x200x100 mm dia***

***200x200x150 mm dia***

***200x200x200 mm dia***

***250x250x80 mm dia***

***250x250x100 mm dia***

***250x250x150 mm dia***

***250x250x200 mm dia***

***250x250x250 mm dia***

***300x300x100 mm dia***

***300x300x150 mm dia***

***300x300x200 mm dia***

---

**300x300x250 mm dia**

***CAP***

***100 mm dia***

***150 mm dia***

***200 mm dia***

***250 mm dia***

***300 mm dia***

***350 mm dia***

***400 mm dia***

***450 mm dia***

***500 mm dia***

***600 mm dia***

***700 mm dia***

***750 mm dia***

***PLUG***

***80 mm dia***

***100 mm dia***

***150 mm dia***

***200 mm dia***

***250 mm dia***

***300 mm dia***

***350 mm dia***

***400 mm dia***

***450 mm dia***

***500 mm dia***

***600 mm dia***

***700 mm dia***

***750 mm dia***

The contractor shall have to procure required ductile iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs, tail pieces, etc. necessary for completion of this item as per site conditions.

The D.I. fittings and specials shall conform to BS-EN 545/1995 class-A series K12 suitable for IS: 8329/1994 with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drilled or machined.

The mass of D. I .Fittings / Specials shall be strictly confirm to IS: 8329/1994 with latest amendments shall have density of Cast as 7050 Kg/mt<sup>3</sup>.

The rates shall be inclusive of all the taxes, duties, loading, unloading, inspection and testing charges, octroi etc. comp. The rates shall be for free delivery at site.

The contractor shall have to procure the required D.I. fittings or specials as per the site conditions and as per direction of Engineer-in-Charge. Excess or Damaged or Broken D.I. fittings/specials shall be removed by the contractor at his own cost and such D.I. fittings/specials will not at all be admitted for its payments.

**MODE OF MEASURMENT & PAYMENT FOR:**

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The payment shall be on the basis of per Kilogram of the D.I. fittings/ specials used for completion of this work. The standard weight prescribed

***Item no.8.33 Providing C.I. Fittings***

***8.33 Providing C.I. Fittings***

***A/S TEE***

***100x100x100 mm dia***

***150x150x100 mm dia***

***150x150x150 mm dia***

***200x200x150 mm dia***

***200x200x200 mm dia***

***250x250x100 mm dia***

***250x250x150 mm dia***

***250x250x200 mm dia***

***250x250x250 mm dia***

***300x300x100 mm dia***

***300x300x150 mm dia***

***300x300x200 mm dia***

***300x300x250 mm dia***

***300x300x300 mm dia***

***350x350x150 mm dia***

***350x350x200 mm dia***

***350x350x250 mm dia***

***350x350x300 mm dia***

***350x350x350 mm dia***

***400x400x100 mm dia***

***400x400x150 mm dia***

***400x400x200 mm dia***

***400x400x250 mm dia***

***400x400x300 mm dia***

***400x400x350 mm dia***

***400x400x400 mm dia***

***450x450x100 mm dia***

***450x450x150 mm dia***

***450x450x200 mm dia***

***450x450x250 mm dia***

***450x450x300 mm dia***

***450x450x350 mm dia***

***450x450x400 mm dia***

***450x450x450 mm dia***

***500x500x100 mm dia***

***500x500x150 mm dia***

***500x500x200 mm dia***

***500x500x250 mm dia***

***500x500x300 mm dia***

***500x500x350 mm dia***

*500x500x400 mm dia*

*500x500x450 mm dia*

*500x500x500 mm dia*

*600x600x100 mm dia*

*600x600x150 mm dia*

*600x600x200 mm dia*

*600x600x250 mm dia*

*600x600x300 mm dia*

*600x600x350 mm dia*

*600x600x400 mm dia*

*600x600x450 mm dia*

*600x600x500 mm dia*

*600x600x600 mm dia*

*700x700x150 mm dia*

*700x700x500 mm dia*

*700x700x700 mm dia*

*750x750x100 mm dia*

*750x750x150 mm dia*

*750x750x200 mm dia*

*750x750x400 mm dia*

*750x750x450 mm dia*

*750x750x500 mm dia*

*750x750x600 mm dia*

*750x750x750 mm dia*

**LINE COLLAR**

*100 mm dia*

*150 mm dia*

*200 mm dia*

*250 mm dia*

*300 mm dia*

*350 mm dia*

*400 mm dia*

*450 mm dia*

*500 mm dia*

*600 mm dia*

*700 mm dia*

*750 mm dia*

The contractor shall have to procure required ductile iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs, tail pieces, etc. necessary for completion of this item as per site conditions.

The D.I. fittings and specials shall conform to BS-EN 545/1995 class-A series K12 suitable for IS: 8329/1994 with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drilled or machined.

The mass of D. I .Fittings / Specials shall be strictly confirm to IS: 8329/1994 with latest amendments shall have density of Cast as 7050 Kg/mt<sup>3</sup>.

The rates shall be inclusive of all the taxes, duties, loading, unloading, inspection and testing charges, octroi etc. comp. The rates shall be for free delivery at site.

The contractor shall have to procure the required D.I. fittings or specials as per the site conditions and as per direction of Engineer-in-Charge. Excess or Damaged or Broken D.I. fittings/specials shall be removed by the contractor at his own cost and such D.I. fittings/specials will not at all be admitted for its payments.

MODE OF MEASUREMENT & PAYMENT FOR:

The payment shall be on the basis of per Kilogram of the D.I. fittings/ specials used for completion of this work. The standard weight prescribed

### ***Item no.8.34 Providing Spun Yarn***

#### ***8.34 Providing Spun Yarn for lead joint***

Mode of the measurement and payment:-

The rate shall be for unit of Kg.

The work shall be carried out by as directed by the Engineer-in-charge.

### ***Item no.8.35 Providing pig lead joint***

#### ***8.35 Providing pig lead joint***

Mode of the measurement and payment:-

The rate shall be for unit of Kg.

The work shall be carried out by as directed by the Engineer-in-charge.

### ***Item no.8.36 Providing, supplying, lowering, laying, jointing of MDPE pipe***

***8.36 Providing, supplying, lowering, laying, jointing of MDPE pipe conforming to ISO - 4427 including compression fitting conforming to ISO/DIS 14236 such as female adopter, elbow, bend, reducer, Tee required for house service connection inclusive of all taxes, insurance, transportation, freight charge, inspection charges, hydro testing etc. complete. The item also includes dismantling of asphalt / metal road, excavation, refilling, watering, ramming, consolidation and restoration of road etc. complete.***

***(1) 20 mm dia.***

***(2) 32 mm dia.***

***(3) 50 mm dia.***

***(4) 63 mm dia.***

MDPE pipe PE-80 shall conform to latest amendments of ISO-4427. Bidder shall supply the required diameter and length of pipe ISI marks at his cost. The pipe end shall be cut at right angle to the pipe axis. The each pipe shall clearly and indelibly marked. The rate shall be inclusive transportation at site.

#### **1. Raw Material**

Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilizers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/cm<sup>3</sup> confirming to latest amendments of ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

#### **2. Effects on Water Quality:**

The MDPE PE 80 Blue Pipes shall confirm to latest amendments of ISO 4427 for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW/KIWA/SPGN/WRC-NSF and certificate of compliance to be produced for the following parameters :

- a. Odour & Flavour of Water
- b. Appearance of Water
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (CytoToxicity)
- e. Extraction of Metals

### 3. Pressure Rating:

The Pressure rating of MDPE Blue PE 80 Pipes shall be conforming to ISO 4427 : 1996 or its latest amendments.

### 4. Colour of Pipes:

The Colour of MDPE PE 80 Pipes shall be BLUE conforming to ISO 4427 : 1996 or its latest amendments.

### 5. Dimensions:

The pipe dimensions shall be as per latest revisions of ISO 4427 : 1996 and pipes upto diameters 32 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996 or its latest amendments. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 80 Pipes shall be as per latest amendments of ISO 4427.

The dimension tolerances shall be as per latest amendments of ISO 4427.

### 6. Performance requirements

The Pipe supplied should have passed the acceptance test as per latest amendments of ISO 4427. The manufacturer should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density,
3. Oxidation and Induction test,
4. Hydrostatic Test ,
5. Pigment dispersion Test,
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge.

## TECHNICAL SPECIFICATIONS FOR COMPRESSION FITTINGS

### 90 DEG COMPRESSION ELBOW WITH METAL INSERT

**One end of the Metal threaded compression Elbow will be with Taper male threads & other end will have compression fitting suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.**

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrustring black in colour, Nut blue in colour. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clampring material will be Polyacetal (POM) white colored and shall not be connected to thrustring. Male threaded part will be made of SS 304.

The product will be tested as per below

Typetest	Standard
Dimensions of the threads	ISO7/1
Tightness of the joints	ISO3458
Tightness of the joints when subjected to bending	ISO3503
Resistance to pull-out	ISO3501

Internal under-pressure test	ISO3459
Longtermpressuretest	ISO/DIS14236

### **90 DEG COMP ELBOW with COMPRESSION JOINT BOTH ENDS**

The Compression Elbows will have compression ends in both sides, so that PE pipes can be connected at both ends. Pressure rating will be PN16.

Body, Nut and Thrust Ring will be injection molded from Poly propylene and UV stabilized body & thrust ring black in colour, Nut blue in color. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamping material will be Polyacetal (POM) white colored and shall not be connected to thrusting.

The product will be tested as per below

<b>Typetest</b>	<b>Standard</b>
Dimensions of the threads	ISO7/1
Tightness of the joints	ISO3458
Tightness of the joints when subjected to bending	ISO3503
Resistance to pull-out	ISO3501
Internal under-pressure test	ISO3459
Longtermpressuretest	ISO/DIS14236

### **FEMALE THREADED ADAPTER with METAL OFF TAKE**

**One end of the Female adaptor with metal offtake will be with female threads & other end will have compression fitting suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.**

Body, Nut and Thrust Ring will be injection molded from Poly propylene and UV stabilized body & thrust ring black in color, Nut blue in color. Lip gaskets in Food safe Rubber (NBR) black color must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Polyacetal (POM) white coloured and shall not be connected to thrusting. Female threaded part will be made of SS 304.

The product will be tested as per below :

<b>Typetest</b>	<b>Standard</b>
Dimensions of the threads	ISO7/1
Tightness of the joints	ISO3458
Tightness of the joints when subjected to bending	ISO3503
Resistance to pull-out	ISO3501
Internal under-pressure test	ISO3459
Longtermpressuretest	ISO/DIS14236

The pipe and fitting shall be lowered, laid and joint using electro-fusion process and hydraulic testing shall be done as specified above in electro-fusion fitting.

**Or**

Compression fittings used for House service connection comply as per latest amendments of ISO 14236.

#### **Material of Construction**

Compression fittings material shall conform to latest amendments of ISO14236

A .Body-Polypropylene

b. Nut / Cap –Polypropylene.

- c. Clip Ring-POM (Acetylic resin )
- d. Packing bush- Polypropylene
- e. “O” ring – NBR
- f. Threaded metal inserts –SS 304 with BSP Threads

**Pressure testing**

The pressure rating of compression fittings as per latest amendments of ISO 14236 which shall be PN16

**Dimensions:**

The Dimension of compression fittings shall be as per latest amendments of ISO 14236

**Performance requirements**

The compression fittings shall be tested as per latest amendments of ISO 14236.

Following Test methods shall be performed.

Clause 8.2.1 -Leak tightness under internal pressure.

Clause 8.2.2 -Resistance to Pull out.

Clause 8.2.3 -Leak tightness under Internal Vacuum.

Clause 8.2.4 -Long term Pressure Test for Leak tightness for assembled joint

Clause 8.3.2.1 -MRS Value as per ISO 9080

Clause 8.3.3.1 -Resistance to Internal pressure.

**Effects on Quality of Water**

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc –NSF and certificate of compliance to be produced for the following parameters :

a. Odour&Flavour of Water.

b. Appearance of Water.

c. Growth of Micro Organism

d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)

e. Extraction of Metals.

For clear identification of the water services, the nuts of the fittings should be coloured blue while the body to be black. All fittings with threaded ends should be with BSP threads.

**Excavation****General**

Any soil which generally yields to the application of pick axe sand shovels, phawaras rakes or any such ordinary excavating implement or organics oil, gravel, silt and turf loam, clay, peat etc. fall under this category.

**Clearing the site**

The site on which the structure is to be built shall be cleared, and all obstructions, loose stone, materials and rubbish of all kind, bush, woodan dtrees shall be removed as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50m. lead. The root soft he trees coming in the sides shall be cut and coated with a hot asphalt.

The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

**Settingout**

After clearing the site, the centre lines will be given by the Engineer in charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts for the work. Contractor shall supply labours, materials, etc. required for setting out there ference mark sand benchmark sand shall maintain the mas long as required and directed.

### **Excavation**

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary showing and shutting or providing necessary slopes to as afeangle, a this own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transferely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level, if by mistake or any other reason excavations is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation upto 1.5m.depth shall be measured under this item.

### **Disposal of the excavated stuff**

The excavated stuff of the selected type shall be use din filling the trenches and plinth or levelling the ground in layers including ramming and watering etc.

The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead upto 50m. and all lift.

### **Dismalting of asphalt / metal road**

Under this item contractor shall demolish existing asphalt or WBM / CC pavement met with during laying pipe.

Only area of pavement intercepted in pipe laying shall bed emolished. If excess area is demolished same shall be reinstated by the contractor.

Demolished material like asphalt pavement lump and metal shall be stacked separately as directed by the Engineer in charge.

Work done to the extent of requirement for laying of drain and as per specifications shall be measured in sq.m. and paid at the tender rate.

### **Mode of measurements and payment**

The description of each item shall, unless otherwise stated, be held to include where necessary, conveyance, and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting in position, straight, cutting and waste, return of packings etc.

The length shall be measured on running metre basis of finished work. The length shall be taken along the centre line of the pipe and fittings. The pipes fixed to walls, ceiling, floors etc. shall be measured and paid under this item.

All the work shall be measured in decimal system as fixed in its place, subject to tolerance given below unless otherwise stated.

(i) Dimensions shall be measured to the nearest 0.01 metre. (ii) Area shall be worked out to the nearest 0.01 sq.metre.

All measurements of cutting shall unless otherwise stated be held to include the consequent waste.

In case of fitting of unequal bore, the largest bore shall be measured for the test.

Testing of pipe lines, fittings and joints include for providing all plant and appliances necessary for obtaining access to the work to be tested and carrying out the tests.

The rate includes all the fittings such as female adopter, elbow, bend, reducer, coupling etc. required for the water meter connection.

The rate shall be for a unit of one running metre.

- (a) 80% payment against supply of pipes and fittings  
 (b) 20% payment against successful ETC

***Item no.8.37 Providing, supplying and fixing Ductile Iron strap saddle***

***8.37 Providing, supplying and fixing Ductile Iron strap saddle inclusive of of all taxes, insurance, transportation, freight charge, inspection charges etc. complete as per the detailed specification.***

***(i) 100 to 300 mm x 15 mm***

***(ii) 100 to 300 mm x 32 mm***

***(ii) 100 to 300 mm x 50 mm***

***(iii)100 to 300 mm x 63 mm***

**DI Strap Saddle required for providing house service connections on DI/CI mains.**

**1 General specification:**

Strap saddles shall be suitable for CI/DI pipes of nominal size 60 mm to 300 mm with nominal outlet connection size from ½”, ¾” & 1” BSP female thread.

The body shall be **Resicoat® epoxy** coated with thickness >250 micron as per GSK standard & EN 14901. The saddles shall be single type up to pipe sizes of NB 300 and service outlet of ½”, ¾” and 1” BSP female thread.

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size 1/2” (M12) shall be used.

Saddle strap shall be with NBR protection rubber.

The sealing between the saddle and mains shall be obtained by using a profiled elastomeric seal matching to the curvature of the pipe. The seal shall be of NBR elastomeric type, suitable for all potable water applications.

The clamp saddles shall be suitable for online tapping with spatula & drilling tool, maximum working pressures upto **16 bars**.

**Material and Design Specifications**

**Saddle body :** **DIGGG40** with **Resicoat® epoxy** (for corrosion protection of fittings) coating with length 172mm, width75mm, height 67mm & thread depth 24.5mm. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted bythe body while fastening the saddle straps & body on th epipe.

**Saddle strap:** Saddle straps shall be made of stainless **steel 304 grade, gauge 16 & width 40mm** to prevent corrosion over the long service life & should be with noweld joint to a void in consistency of strength.

**Strap Protection Rubber:** NBRUV protected Elastomeric (rubber) shall be such that none of the Stainless Steel Strap is indirect contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe due to external loading.

**Saddle seal :** It shall be virgin rubber NBR Class 70 complying with EN682-2002. It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be, with the outlet section having o-ring contacting the saddle body.

**Nuts–Bolts–Washer :** Stainless Steel Type 304, N Crolled thread, Tightening torque for ½”(M12) nut-bolt : 14-15 kgm.

**OR**

## Specifications for Clamp Saddle for Service Connections

### General Specifications :

Clamp saddles for service connection from water distribution mains shall be of wrap around design, wide skirt and wide straps support, which shall reinforce the pipe while providing excellent stability to the saddle.

Clamp Saddles for service connections shall be of fastened strap type with threaded outlet for service connection.

The service connection threading sizes shall be conforming to latest amendments of IS: 554

Clamp saddles shall be suitable for DI pipes of nominal size 3" (NB 80) to 12" (NB 300) with nominal service connection size from ½" (NB 15), ¾" (NB 20), 1" (NB 25), 1 ¼" (NB 32), 1 ½" (NB 40) and 2" (NB 50).

The straps shall be elastomer coated (insulated) type for firm grip on pipe as well as to protect the coating on the pipe and to insulate the un-identical metals. The saddles shall be single strap type upto pipe sizes of NB 600 and service outlet of ½", ¾" and 1".

The saddles shall be double strap type for pipe sizes above NB 600 or when the service outlet is 1 ¼", 1 ½" or 2".

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size ½" (M12) shall be used for saddles of size up to 4" (NB 100) and Nut-bolts of size 5/8" (M16) shall be used for saddles of size 6" (NB 150) and above.

The sealing between the saddle and mains shall be obtained by using a profiled elastomer seal matching to the curvature of the pipe.

The seal shall be of elastomer type, suitable for all potable water applications.

The Material of construction of the body, straps, fasteners etc. shall be of a non corrosive material such as engineering plastic (PE/PP) or stainless steel or a combination of both.

The design of the saddle body should be such that, the service connection outlet metal insert shall project out towards pipe side and align with the hole drilled on the pipe to ensure positive locking against rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

The clamp saddles shall be suitable for maximum working pressures upto 10 bars.

### Material and Design Specifications:

<b>Saddle Body:</b>	Non corrosive Engineering Plastic body moulded with Stainless steel threaded metal insert for tapping outlet. Also, the stirrup metal plate shall be duly embedded in the plastic body, except at the place of nut-bolt lugs. Threading size and dimensions shall conform to latest amendments of IS: 554. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.
<b>Saddle Strap:</b>	Saddle straps shall be made of stainless steel 304 grade to prevent corrosion over the long service life.
<b>Strap Insulation:</b>	Elastomeric (rubber) insulation / lining shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe to prevent the saddle from rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.
<b>Saddle Seal:</b>	It shall be virgin rubber SBR Grade 30 / NBR (NSF 61 approved). It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be gridded mat, with tapered ends, with the outlet section

having oring contacting the saddle body multiple o-rings contacting the pipe, preferably with a Stainless steel reinforcing ring insert moulded to prevent expansion under pressure.

**Nuts-Bolts- washer:** Stainless Steel Type 304, NC rolled thread, Tightening torque for ½” (M12) nut-bolt: 14-15 kg.m and for 5/8” (M 16) nutbolt: 21-23 kg.m

The payment shall be made as per number basis.

- (a) 80% payment against supply of Strap Saddle
- (b) 20% payment against successful ETC

### ***Item no.8.38 Providing and fixing brass ferrule***

***8.38 Providing and fixing brass ferrule of approved make of following sizes inclusive of all taxes, insurance, transportation etc. complete.***

- (i) 15 mm dia.(1/2")***
- (ii) 25 mm dia.(1")***
- (iv) 40 mm dia.(1.5")***
- (v) 50 mm dia -(2").***

- 1 The brass ferrule shall be best quality and make as approved by Engineer-incharge.
- 2 The work shall be carried out in good workmanship manner as directed by the Engineer - in- charge with proper fixing of ferrule as required.
- 3 The payment shall be made as per number basis.
  - (a) 80% payment against supply of Brass Ferrule

### ***Item no.8.39 Providing, supplying and fixing U-PVC ball Valves***

***8.39 Providing, supplying and fixing U-PVC ball Valves with compression end on one side to connect PE Pipes and female threading on the other side for connecting BSP threaded fittings or pipes. The product shall confirm to ISO 4422-4 Standards. The rate shall be inclusive of all taxes, insurance, transportation etc. complete.***

- (i) 20 mm dia.x 1/2"***
- (ii) 32 mm dia.x 1"***
- (iii) 50 mm dia.x 1.5"***
- (iv) 63 mm dia.x 2"***

The U PVC ball Valves will have Compression end on one side to connect PE Pipes and female threading on the other side for connecting BSP threaded fittings or pipes. The product shall confirm to ISO 4422-4 Standards or its latest amendments and pressure rating will be PN 16. The product should be suitable for use in drinking water for human consumption.

Body, Nut and Thrust Ring will be injection molded from Poly propylene and UV stabilized body & thrustring black in color, Nut blue in color Lip gaskets / OR ingin Food safe Rubber (NBR) black color must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Poly acetal (POM) white coloured and shall not be connected to thrustring.

The Compression Fittings & U PVC Ball Valves for drinking water applications should have under gone type test by WR c- NSF, U.K. according to BS 6920 and a certificate from

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either WR c- NSF or WRAS (Water Regulations Advisory Scheme) should be available evidencing this fact.

The payment shall be made as per number basis.

- (a) 80% payment against supply of UPVC Ball Valve
- (b) 20% payment against successful ETC

***Item no.8.40 Cutting of Groove***

***8.40 Cutting of Groove 5 to 7 mm thick in CC for depth 1/3 of total thickness with filling of epoxy sealant as directed by engineer in charge***

Mode of the measurement and payment:-

The rate shall be for unit of Rmt.

The work shall be carried out by as directed by the Engineer-in-charge.

**Date & Signature of the Contractor**

**Executive Engineer  
South Zone-A (Udhana)  
Surat Municipal Corporation**