

## **Item wise Detailed Specifications**

### **Item No 1**

**Clearing and grubbing of road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees of girth upto 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials. (C) By Mechanical means in area of light Jungle.**

#### **1.1. Scope**

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed less than one month in advance of earthwork operations and in accordance with the requirements of these specifications. Areas requiring clearing and grubbing shall be determined by the Engineer. The contractor shall arrange for all the permissions from competent government authorities for completion of this item.

#### **1.2. Preservation of Property/Amenities**

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

#### **1.3. Methods, Tools and Equipments**

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the subgrade. Notwithstanding the above provisions, the Contractor shall obtain the Engineer's express approval before removing any trees with diameter greater than 100mm. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several meters, shall be suitably treated.

#### 1.4 Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lifts and upto a lead of 2000 m.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

#### 1.5. Measurements for Payment

Clearing grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 300 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations.

**The payment shall be made unit of a Hectare.**

**Item no.2. Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed upto 200 Meters from the end of cutting with all lead and lift.**

**Note:- Contractor shall prepare contour sheets of original ground level and proposed formation levels which shall be approved from Superintending Engineer, Ahmedabad. Only after approval, contractor shall start the work.**

**Work execution as per below Morth specification.**

##### **301.1** *Scope*

This work shall consist of excavation, removal and disposal of materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and subgrade construction suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, with all leads and lifts, reuse of cut materials as may be deemed fit, trimming and finishing of the road to specified dimensions or

as directed by the Engineer.

##### **301.2** *Classification of Excavated Material*

**301.2.1 Classification :** All materials involved in excavation shall be classified by the Engineer in the following manner:

a) Soil :

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black-cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging equipment. Removal of gravel or any other modular material having dimension in any one direction not exceeding 75 mm shall be deemed to be covered under this category.

b) Ordinary Rock (not requiring blasting) This shall include :

- i) rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting;
- ii) macadam surfaces such as water bound and bitumen bound; soling of roads, cement concrete pavement, cobble stone, etc. compacted moorum or stabilized soil requiring use of pick axe or shovel or both.
- iii) lime concrete, stone masonry and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level; and
- iv) boulders which do not require blasting found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin.

c) Hard Rock (requiring blasting)

This shall comprise :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required,
- ii) reinforced cement concrete below ground level and in bridge/ROB/RUB/flyover piers and abutments,
- iii) boulders requiring blasting.

d) Hard Rock (using controlled blasting) :

Hard rock requiring blasting as described under (c) but where controlled blasting is to be carried out in locations where built-up area, huts, and are situated at within 200 m of the blast site.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason like people living within 20 m of blast sites etc. and excavation has to be carried out by chiselling, wedging or any other agreed method.

f) Marshy soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

**301.2.2** *Authority for Classification*

The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

**301.3** *Construction Operations*

**301.3.1** **Setting Out**

After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. Clause 109 shall be applicable for the setting out operations.

**301.3.2** *Stripping and Storing Topsoil*

When so directed by the Engineer, the topsoil existing over the sites of excavation shall be

stripped to specified depths and stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired in accordance with Clause 305.3.3. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots, with approval of the Engineer.

### **301.3.3**            *Excavation-General*

All excavations shall be carried out in conformity with the directions laid here-in-under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as deemed fit or as approved by the Engineer.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc. as per Clause 306, and take appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/width excavated beyond the specified levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 305.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an appropriate manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimize erosion and ponding, allowing for natural drainage to take place.

### **301.3.4**            *Methods, Tools and Equipment*

Only such methods, tools and equipment as approved by the Engineer shall be adopted/ used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

### **301.3.5**            *Rock Excavation*

Rock, when encountered in road excavation, shall be removed upto the formation level or as otherwise indicated in the drawings. Where, however, unstable shales or other unsuitable materials are encountered at the formation level, these shall be excavated to the extent of

500 mm below the formation level or as otherwise specified. In all cases, the excavation operations shall be so carried out that at no point on cut formations the rock protrudes above the specified levels. Rocks and boulders which are likely to cause differential settlement and also local drainage problems shall be removed to the extent of 500 mm below the formation level in the formation width including side drains.

Where excavation is done to levels lower than those specified, the excess excavation shall be made good as per Clauses 301.3.3 and 301.6 to the satisfaction of the Engineer.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the Engineer. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when pierced by a crowbar shall be removed.

Where blasting is to be resorted to, the same shall be carried out as per Clause 302 and all precautions indicated therein observed.

Where presplitting is prescribed to be done for the establishment of a specified slope in rock excavation, the same shall be carried out as per Clause 303.

#### **301.3.6**                    *Marsh Excavation*

The excavation of soil from marshes/swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of backfilling with materials like boulders, sand moorum, bricks bats, dismantled concrete as approved by the Engineer. The method and sequence of excavating and backfilling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits indicated on the drawings or as staked by the Engineer.

#### **301.3.7**                    *Excavation of Road Shoulders/Verge/Median for Widening of Pavement or Providing Treated Shoulders*

In the works involving widening of existing pavements or providing paved shoulders, the existing shoulders/verge/median shall be removed to its full width and upto top of the subgrade. The subgrade material within 500 mm from the bottom of the pavement for the widened portion or paved shoulders shall be loosened and recompact as per Clause 305. Any unsuitable material found in this portion shall be removed and replaced with the suitable material. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the

disturbed/loosened portion removed completely and relaid as directed by the Engineer, at the cost of the Contractor.

#### **301.3.8**                    *Excavation for Surface/Sub-Surface Drains*

Where the Contract provides for construction of surface/sub-surface drains, the same shall be done as per Clause 309. Excavation for these drains shall be carried out in proper sequence with other works as approved by the Engineer.

#### **301.3.9**                    *Slides*

If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

#### **301.3.10**                  *Dewatering*

If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

#### **301.3.11**                  *Use and Disposal of Excavated Materials*

All the excavated materials shall either be reused with the approval of the Engineer or disposed off with all leads and lifts as directed by the Engineer.

#### **301.3.12**                  *Backfilling*

Backfilling of masonry/concrete hume pipe or drain excavation shall be done with approved material with all leads and lifts after concrete/masonry/hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and/or not to cause differential settlement. All space between the drain walls and the side of the excavation

shall be backfilled to the original surface making due allowance for settlement, in layers not exceeding 150 mm compacted thickness to the required density, using suitable compaction equipment such as trench compactor, mechanical tamper, rammer or plate compactor as directed by the Engineer.

#### **301.4**                    *Plying of Construction Traffic*

Construction traffic shall not use the cut formation and finished subgrade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own cost.

#### **301.5**                    *Preservation of Property*

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers, sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which, in the opinion of the Engineer, shall be continued in use without any change. Safety measures taken by the Contractor in this respect, shall be got approved from the Engineer. However, if any, of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his cost. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing prior notice to the effect.

#### **301.6**                    *Preparation of Cut Formation*

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/ base course as directed by the Engineer.

Where the material in the subgrade has a density less than specified in Table 300-1, the same shall be loosened to a depth of 500 mm and compacted in layers in accordance with the requirements of Clause 305 adding fresh material, if any required, to maintain the formation level as shown on the drawings. Any unsuitable material encountered in the subgrade level shall be removed as directed by the Engineer, replaced with suitable material and compacted in accordance with Clause 305.

In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with granular base material as directed by the Engineer, laid and compacted in accordance with the respective Specifications for these materials. The unsuitable material shall be disposed of in accordance with Clause 301.3.11. After satisfying



the density requirements, the cut formation shall be prepared to receive the sub-base/base course in accordance with Clauses 310 and 311.

### **301.7**                    *Finishing Operations*

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (ordinary or hard) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Clause 902.

Where directed, the topsoil removed and conserved (Clauses 301.3.2 and 305.3.3) shall be spread over cut slopes, shoulders and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 100 mm.

### **301.8**                    *Measurements for Payment*

Excavation for roadway shall be measured by taking cross-sections at suitable intervals before the excavation starts (after clearing and grubbing/stripping etc. as the case may be) and after its completion and computing the volumes in cu.m by the method of average end areas for each class of material encountered. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods.

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.

For rock excavation, the overburden shall be removed first so that necessary cross-sections could be taken for measurement. Where cross-sectional measurements could not be taken due to irregular configuration or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of measurement of stacks of excavated rubble allowing a deduction of 35% therefrom. When volume is calculated on the basis of measurement of stacks of the excavated material other than rock, a deduction of 16% of stacked volume shall be allowed.

Works involved in the preparation of cut formation shall be measured in units indicated below:

i)	Loosening and recompacting the loosened material at subgrade	...cu.m
ii)	Loosening and removal of unsuitable material and replacing with suitable material and compacting to required density	...cu.m
iii)	Preparing rocky subgrade	...sq.m
iv)	Stripping including storing and reapplication of topsoil	...cu.m

### **301.9**                *Rates*

**301.9.1**                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 for use or disposal with all leads and lifts by giving suitable credit towards the cost of re-usable material and salvage value of unusable material;
- iii)   trimming bottoms and slopes of excavation;
- iv)    dewatering;
- v)     keeping the work free of water as per Clause 311;
- vi)    arranging disposal sites; and
- vii)   all labour, materials, tools, equipment., safety measures, testing and incidentals necessary to complete the work to Specifications.

Where presplitting of rock is prescribed it shall be governed by Clause 303.5.

**301.9.2**                The Contract unit rate for loosening and recompacting the loosened materials at subgrade shall include full compensation for loosening to the specified depth, including breaking clods, spreading in layers, watering where necessary and compacting to the requirements.

**301.9.3**                Clauses 301.9.1 and 305.8 shall apply as regards Contract unit rate for item of removal of unsuitable material and replacement with suitable material respectively.

**301.9.4**                The Contract unit rate for item of preparing rocky sub-grade as per Clause 301.6 shall be full compensation for providing, laying and compacting granular base material for correcting surface irregularities including all materials, labour and incidentals necessary to complete the work and all leads and lifts.

**301.9.5** The Contract unit rate for the items of stripping and storing topsoil and of reapplication of topsoil shall include full compensation for all the necessary operations including all lifts and leads.

**Item no. 3 :- Earthwork for embankment including breaking clods, dressing with all lead and lift (excluding watering and consolidation) From Borrow area within 3.0 Km. lead.**

**and**

**Item no 4:- Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T.(A) From Borrow pits within land width.**

**Note:- 500 mm Subgrade with Minimum CBR of 12%**

**(12% of CBR will be achieved by rolling and compacting existing subgrade top layer and location specific tests results will be submitted before start of construction)**

**Work execution as per below Morth specification.**

## **302 EMABANKMENT CONSTRUCTION**

### **302.1** *General*

#### **302.1.1** **Description**

These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed 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.

### **302.2** *Materials and General Requirements*

#### **302.2.1** **Physical Requirements**

**302.2.1.1** The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, reclaimed material from pavement, fly ash, pond ash, a mixture of these or any other material as approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment.

The following types of material shall be considered unsuitable for embankment:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS:1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;

- e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25;  
and
- f) Materials with salts resulting in leaching in the embankment.

**302.2.1.2** Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 percent when tested as per IS:2720 – Part 40) shall not be used as a fill material. Where an expansive clay having "free swelling index" value less than 50 percent is used as a fill material, subgrade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

**302.2.1.3** Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per litre when tested in accordance with BS:1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm distance (or any other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Materials with a total sulphate content (expressed as SO<sub>3</sub>) exceeding 0.5 percent by mass, when tested in accordance with BS:1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

**302.2.1.4** The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size in such cases, however, shall not be more than two-thirds of the compacted layer thickness.

**302.2.1.5** Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub-grade.

**Table 300-1 : Density Requirements of Embankment and Sub-grade Materials**

S. No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8)
1)	Embankments up to 3 m height, not subjected to extensive flooding	Not less than 15.2 kN/cu.m
2)	Embankments exceeding 3 m height or embankments of any height subject to long periods of inundation	Not less than 16 kN/ cu.m
3)	Subgrade and earthen shoulders/verges/backfill	Not less than 17.5 kN/cu.m

**Notes:** 1) This Table is not applicable for lightweight fill material, e.g., cinder, fly ash, etc.

- 2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer shall be followed.

**302.2.1.6** The material to be used in subgrade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available

materials fails to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Accreditation Committee shall be followed.

**302.2.1.7** The material to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

### **302.2.2** *General Requirements*

**302.2.2.1** The materials for embankment shall be obtained from approved sources with preference given to acceptable materials becoming available from nearby roadway excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.

### **302.2.2.2** *Borrow Materials*

The arrangement for the source of supply of the material for embankment and sub-grade and compliance with the guidelines, and environmental requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width of a minimum of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

### **302.2.2.3**      *Fly-Ash*

Use of fly-ash shall conform to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC:SP:38-2001, "Guidelines for Use of Flyash in Road Construction". The term fly-ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash.

Embankment constructed out of fly ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond ash for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500 mm.

### **302.2.2.4**      *Compaction Requirements*

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 300-2 shall yield the specified design CBR value of the sub-grade.

**Table 300-2 : Compaction Requirements for Embankment and Sub-grade**

<b>S. No.</b>	<b>Type of work/material</b>	<b>Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)</b>
1)	Subgrade and earthen shoulders	Not less than 97%
2)	Embankment,	Not less than 95%
3)	Expansive Clays	
	a) Subgrade and 500 mm portion just below the subgrade	Not allowed
	b) Remaining portion of embankment	90-95%

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

- i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- ii) A graph of dry density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

### **302.3**                    *Construction Operations*

#### **302.3.1**                **Setting Out**

After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1 The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

#### **302.3.2**                *Dewatering*

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate for the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

#### **302.3.3**                *Stripping and Storing Topsoil*

When so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

#### **302.3.4**                *Compacting Ground Supporting Embankment/Sub-Grade*

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with Clauses 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in Table 300-2.



In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as given in Table 300-2), the ground shall be loosened upto a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be removed, suitably disposed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of such material types (a) to (f) in Clause 305.2.1.1 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

### **302.3.5**                    *Spreading Material in Layers and Bringing to Appropriate Moisture Content*

**302.3.5.1**                The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250 mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

**302.3.5.2**                Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, using disc harrow until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS:2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

**302.3.5.3** Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other construction vehicles. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength of the material before it was damaged.

Embankments and unsupported fills shall not be constructed with steeper side slopes or to greater widths than those shown in the drawings, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material,

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical to 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

### **302.3.6**            *Compaction*

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three-wheeled roller, self propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot

roller, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for the site trials shall be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and provided the gauge is calibrated to give results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If inspite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

### **302.3.7**                      *Drainage*

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a crossfall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

### **302.3.8**                      *Repairing of Damages Caused by Rain/Spillage of Water*

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to

ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

### **302.3.9** *Finishing Operations*

Finishing operations shall include the work of shaping and dressing the shoulders/verge/ roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier (Clauses 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirements of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

### **302.4** *Construction of Embankment and Sub-grade under Special Conditions*

#### **302.4.1** **Earthwork for Widening Existing Road Embankment**

When an existing embankment and/or sub-grade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/sub-grade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of light weight vibratory roller, double drum walk behind roller, vibratory plate compactor or vibratory tamper or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

#### **302.4.2**      *Earthwork for Embankment and Sub-Grade to be Placed Against Sloping Ground*

Where an embankment/subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/sub-grade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

#### **302.4.3**      *Earthwork over Existing Road Surface*

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

- i) If the existing road surface is of granular type and lies within 1 m of the new formation levels, it shall be scarified to a depth of 50 mm or as directed so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new sub-grade level is compacted to the desired density;
- ii) If the existing road surface is of bituminous type or cement concrete and lies within 1 m of the new formation level, the bituminous or cement concrete layer shall be removed completely;
- iii) If the level difference between the existing road surface and the new formation level is more than 1 m, the existing surface shall be roughened after ensuring that the minimum thickness of 500 mm of subgrade is available.

#### **302.4.4**      *Embankment and Sub-Grade Around Structures*

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points, to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures upto a distance of twice the height of the road from the back of the abutment shall be carried out

independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and sub-grade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS:2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in IRC:78. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2504 unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

#### **302.4.5**            *Construction of Embankment over Ground Incapable of Supporting Construction Equipment*

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

## **302.4.6**      *Embankment Construction under Water and Waterlogged Areas*

### **302.4.6.1**      **Embankment Construction under Water**

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS:1498 and consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

### **302.4.6.2**      *Embankment Construction in Waterlogged and Marshy Areas*

The work shall be done as per IRC:34.

### **302.4.7**      *Earthwork for High Embankment*

The material for high embankment construction shall conform to Clause 305.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area.

Where provided, stage construction of embankment and controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results the Contractor shall bring the resultant level up to formation level with acceptable material for use in fill.

### **302.4.8**      *Settlement Period*

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

## **302.5**      *Plying of Traffic*

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own cost as directed by the Engineer.



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

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

## **302.7**                    *Sub-grade Strength*

**302.7.1**                It shall be ensured prior to actual execution that the material to be used in the sub-grade satisfies the requirements of design CBR.

**302.7.2**                Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on remoulded samples, compacted to the field density at the field moisture content and tested for soaked/unsaturated condition as specified in the Contract.

## **302.8**                    *Measurements for Payment*

**302.8.1**                Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals given in Sub-Section 113.3 after completion of clearing and grubbing and after completion of embankment/sub-grade. The volume of earthwork shall be computed in cubic metres by the method of average end areas.

**302.8.2**                The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m of suitable material brought to site from road and drainage excavation forms one cu.m of compacted fill and all bulking or shrinkage shall be ignored.

**302.8.3**                The embankment constructed with fly ash will be measured in cu.m, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the Contract.

**302.8.4**                Construction of embankment under water shall be measured in cu.m.

**302.8.5**                Construction of high embankment with specified material and in specified manner shall be measured in cu.m.

**302.8.6**                Stripping including storing and reapplication of top soil shall be measured in cu.m.

**302.8.7**                Work involving loosening and recompacting of ground supporting embankment/sub-grade shall be measured in cu.m.



**302.8.8** Removal of unsuitable material at embankment/sub-grade foundation and replacement with suitable material shall be measured in cu.m.

**302.8.9** Scarifying existing granular/bituminous road surface shall be measured in square metres.

**302.8.10** Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.

**302.8.11** Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

**302.9** *Rates*

**302.9.1** The Contract unit rates for the items of embankment and sub-grade construction shall be payment in full for carrying out the required operations including full compensation for:

- i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract;
- ii) Setting out;
- iii) Compacting ground supporting embankment/sub-grade except where removal and replacement of suitable material or loosening and recompact is involved;
- iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and sub-grade as applicable;
- v) Cost of watering or drying of material in borrow areas and/or embankment and sub-grade during construction as required;
- vi) Spreading in layers, bringing to appropriate moisture and compacting to Specification requirements;
- vii) Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners;
- viii) Restricted working at sites of structures;
- ix) Working on narrow width of embankment and sub-grade;
- x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and sub-grade site with all leads and lifts unless otherwise provided for in the Contract;
- xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications;
- xii) Dewatering; and

xiii) Keeping the embankment/completed formation free of water as per Clause 311.

xiv) Transporting unsuitable excavated material for disposal with all leads and lifts.

**302.9.2** Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil including reapplication of topsoil.

**302.9.3** Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and recompacting the embankment/sub-grade foundation.

**302.9.4** Clauses 309.1.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material, respectively.

**302.9.5** The Contract unit rate for scarifying existing granular/bituminous road surface 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. This will also comprise of handling, giving credit towards salvage value and disposal of the dismantled materials with all leads and lifts or as otherwise specified.

**302.9.6** Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

**302.9.7** The Contract unit rate for providing and laying filter material shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

**302.9.8** The Contract unit rate for providing and compacting backfill material behind abutments and retaining walls shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

**302.9.9** Clause 305.4.6 shall apply as regards Contract unit rate for construction of embankment under water.

**302.9.10** Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

#### **Item no.5**

**Rolling and consolidation of existing soil including filling in depression which occur during the process, with power roller 8 tonne to 12 tonne.**

Rolling to be carried out on top surface of existing soil with power roller as per instructions of Engineer incharge. The top surface of soil after rolling & consolidation shall be as per required camber and gradient as approved by engineer in-charge.

### 1. Scope of Work

This specification covers the methodology for rolling and consolidating the soil layer, ensuring a uniformly compacted surface with proper camber and gradient, as per the instructions of the Engineer-in-Charge and relevant Indian Standards.

### 2. Applicable Standards

1. **IS 2720 (Part 8)**: Determination of water content and dry density relationship of soil.
2. **IS 10379**: Rolling and compaction equipment standards.
3. **IRC: 36-2010**: Recommended practice for the construction of granular sub-base.
4. **IS 3764**: Safety code for excavation work.

### 3. Equipment and Materials

#### 1. Power Roller:

- o Type: Smooth-wheeled, self-propelled.
- o Weight: 8–12 tonnes, as per design requirements.

#### 2. Filling Material:

- o Excavated soil free from debris, organic matter, and oversized particles (maximum size: 40 mm for granular sub-base).
- o Moisture content adjusted to optimum moisture content (OMC) before placement.

### 4. Pre-Rolling Preparation

#### 1. Surface Cleaning:

- o Remove debris, loose material, and vegetation from the soil surface.
- o Ensure no standing water is present; if necessary, allow time for drying.

#### 2. Inspection:

- o The Engineer-in-Charge must inspect the base layer for level and preliminary slope conformity.

### 5. Rolling and Consolidation Procedure

### 5.1. Initial Rolling

1. Begin rolling along the longitudinal axis of the surface. Start at one edge and work towards the center to achieve proper compaction.
2. Use overlapping passes, ensuring at least one-third overlap on each pass to cover the entire surface uniformly.
3. Rolling should be performed at a consistent speed to avoid uneven compaction.

### 5.2. Handling Depressions

1. Any depressions occurring during rolling must be promptly filled with pre-approved soil.
2. Fill material should be placed in layers no thicker than 150 mm, spread evenly, and compacted using hand tampers or smaller mechanical rollers to the satisfaction of the Engineer.
3. The area should then be re-rolled using the power roller until uniform compaction is achieved.

### 5.3. Final Rolling

1. Conduct final rolling to achieve a smooth surface with the required camber and gradient.
2. Apply water to control dust and maintain the surface's moisture content.
3. Confirm the compacted surface is stable and does not deform under the roller's weight.

### 6. Inspection by Engineer:

- After rolling, the Engineer shall verify compaction density, uniformity, and adherence to specified slope and levels before proceeding further.

All the works shall be carried out as per instruction of engineer in-charge.

In case of any discrepancies, the decision of engineer in charge shall be final and binding on the agency.

In case of any missing detail or any discrepancies, the same shall be brought to the notice of engineer in-charge immediately.

The work shall be carried out till the satisfaction of engineer in-charge

### 7. Safety Provisions

1. Maintain a safe distance between personnel and operating machinery.
2. Use warning signs or barricades around the rolling area.
3. Ensure operators are trained and use personal protective equipment (PPE) such as helmets, gloves, and safety boots.

### 8. Post-Work Requirements

- Remove loose material displaced during the compaction process.
- Re-inspect and record levels to confirm compliance with design specifications.
- Hand over the surface for the next stage of construction only upon formal approval by the Engineer-in-Charge.

### 9. Notes and Special Instructions

1. Avoid rolling during adverse weather conditions, such as heavy rainfall, to ensure consistency in compaction.

2. Ensure continuous availability of filling material to minimize delays during the rolling process.
3. Regularly calibrate the power roller's weight and check functionality to meet rolling standards.

#### **MODE OF MEASUREMENT & PAYMENT:**

The contract unit rate shall be for a unit of one Square meter of finished work at the site of work.

#### **Item No 6**

#### **Graded Granular sub base (GSB)-**

**Providing & laying of compacted thickness of 200 mm Closed Graded Granular sub base (GSB) in Two equal layers (each layer should be less than 200 mm) of graded granular material consisting of river sand, gravel, pabbles and crushed stone aggregate, shingle as per grading - V given in table 400-1 of the specification MORT&H and compactor to the required density with 8 - 10 tonne vibratory roller with plain drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight in all seasons as per MORT&H, maintaining the required slope & grade during the operation as approved by the engineer in charge & watering to the proper moisture content and sprinkled with the help of truck mounted water tank fitted with suitable arrangement. (fully saturated having CBR value minimum 30)**

Scope: 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 or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross - sections shown on the drawings or as directed by the Engineer.

#### **Materials**

The material to be used for the work shall be **machine cut black Trap stone aggregate, as per grading - V given in table 400-1 of the specification MORT&H**. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table 400-1. While the grading in Table 400-1 are in respect of close-graded granular sub- base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding grading for the coarse- graded materials for each of the three maximum particle sizes are given

**TABLE 400-1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS**

IS Sieve	Per cent byweight passing the IS sieve					
Designation	Grading I	Grading II	Grading III	Grading VI	Grading V	Grading VI
75.0 mm	100	--	--	--	100	
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-0	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm					2-10	--
0.425 mm	10-25	10-15	--	--	0-5	0-8

0.075 mm	<5	<5	<5	<5	--	0-3
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TABLE 400-2. GRADING FOR COARSE GRADED GRANULAR SUB -BASE MATERIALS

IS Sieve	Per cent by weight passing the IS sieve		
Designation	Grading I	Grading 11	Grading III
75.0 mm	100	--	--
53.0 mm		100	--
26.5 mm	55-75	50-80	100
9.50 mm	10-30	15-35	25-45
4.75 mm			
2.36 mm			
0.425 mm	<10	<10	<10
0.075 mm			
CBR Value (Minimum)	30	25	20

Note: - The material passing 425 micron (0.425 mm) sieve for all the here grading when vested according to IS : 2720 (Pan 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

#### Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

#### Construction Operations

**Preparation of subgrade:** Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable 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 sub-base material of grading specified in the Contract 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 or other means as approved by the Engineer. When the sub- base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix- in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in -place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet immediately thereafter, rolling shall start. 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 upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot- drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0,7 MN/m<sup>2</sup> or equivalent capacity roller 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 and super- elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides. 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 desired density is achieved 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**

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

**Arrangements for Traffic:** During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112.

**Measurements for Payment:** Granular sub -base shall be measured as finished work in position in cubic metres. The protection of edges of granular sub-base extended over the full formation as shown in the drawing 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: Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions; furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts; all labour, tools, equipment and incidentals to complete the work to the Specifications; carrying out the work in pan widths of road where directed; and carrying out the required tests for quality control.

### **9.0 TESTING OF MATERIAL**

9.1 A site Testing Laboratory shall be set up by the contractor at his own cost. The equipments for following tests, in addition to the equipment already specified, are to be arranged by the contractor.

9.1.1 Aggregate Impact value (IS: 5640)

9.1.2 Sieve Analysis of Coarse and Fine aggregate (IS: 2386 Pt 1)

9.1.3 Flakiness Index (IS: 2386 Pt 1)

9.1.4 Moisture Content (IS: 2720 Pt II)

9.1.5 Plasticity (IS: 2720 Pt V) 9.1.6 Proctor Density test (IS 2720 Pt VIII)

9.1.7 Field Density (IS 2720 Pt III) 9.1.8 Water Absorption test (IS 2720 Pt III)

9.1.9 Surface Moisture Content of aggregates

9.2 Wherever possible, the materials shall be got tested at site lab of the contractor.

The cost of samples including packing, transportation and other incidental charges shall be borne by Contractor.

9.3 The testing of materials, if required by the Officer-in -charge of the Quality control wing of NBCC or his authorized representative, beyond specified frequency of testing shall also be carried out at site laboratory of the

contractor or wherever possible by the contractor without any extra cost. The cost of samples including packing, transportation and other incidental charges shall be borne by the contractor.

9.4 In case the tests are conducted at any laboratory other than site laboratory of the contractor, the testing charges shall be borne by the contractor. Here the selection of laboratory will be done by Engineer-in-charge. However cost of samples including packing, transportation, and other incidental charges shall be borne by the contractor.

9.5 The test result shall be final and binding on the contractor. The decision of Engineer-in-charge in this regard shall be final and binding on the Contractor.

9.6 All necessary tests as per CPWD specification / relevant BIS codes shall be carried out on all the materials whether ISI marked or otherwise. Wherever CPWD specification / relevant BIS codes are not available the tests shall be carried out as per directions of Engineer-in charge. Nothing extra will be payable on this account.

9.7 At the time of handing over of completed work to the department all the damages, pot holes and undulations caused by any traffic shall be made good and road repaired properly by the contractor to the satisfaction of Engineer-in-charge.

Nothing extra shall be payable to the contractor.

9.8 Necessary platforms of required size etc shall be made by the contractor to prevent the blinding material (for W.B.M) and other items of work from coming into direct contact with the local soil. Nothing extra will be payable to the contractor.

9.9 Geo Textile and Geo-grid material testing should be approved by BTRA and the ultimate tensile strength of bi-axial geogrid and remaining material properties should be satisfied as per IRC:113-2013.

10.0 No payment will be made to the contractor for damages caused by cyclones, hurricanes, sand storms, flood waters or by pounding of water due to any reason etc, during execution of the work and no claims on these accounts will be entertained.

11.0 Some restrictions may be imposed by the security staff/BSF/Army etc on the working and /or movement of labour, vehicles, materials etc on BSF Link roads and in Ran of Kutch and contractor shall be bound to follow all such restrictions/ instructions and nothing extra shall be payable on this account or due to less /reduced working hours etc.

12.0 Royalty at the prevalent rates wherever payable, shall have to be paid by the contractors on the boulders, metal, shingle, sand and bajri etc or any other materials collected by him for the work direct to the revenue authority of the District /State Government concerned. He should submit money receipts in lieu of deposits made or obtain clearance from Geological Department for getting released his final bill.

13.0 The contractor shall ensure that sufficient quantity of water (suitable for construction) is available at site for proper execution of work. Nothing extra for arranging of water at site will be paid to the contractor by the corporation.

14.0 Unless otherwise specified in the schedule of quantities, the rates for all items of work shall be considered as inclusive of pumping out or bailing out water from all depths if required for which no extra payment will be made. This will include water encountered from any source, such as rains, floods, sub soil water being high due to any other cause whatsoever etc.

15.0 The malba /garbage, removed from site shall be disposed off by the Contractor at his own cost to any suitable place as directed by Engineer-in-charge.

16.0 The existing salty and slushy layer if any of borrow pits, and earth filling area should be removed and disposed off as directed by the Engineer in charge. Nothing extra shall be paid to the contractor on this account.

17.0 The contractor should make all arrangements for the alignment, survey and fixing the shortest distance by using GPS and measuring the distance by using road meter etc., Nothing extra will be payable on this account

## **Item No 7: Wet Mix Macadam (WMM)- 250mm**

### **Wet Mix Macadam (WMM)**



**Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam in compacted thickness of 250mm specification including trimix the materials with water at OMC in mechanical mix plant carriage of mixed materials by tipper to site laying in uniform layers (Layer should not be more than 200 mm)with paver in sub base/base course on well prepared surface and camber with Sensor paver consolidation by vibratory road roller to achieve the desired density by using machine crushed chips as per required gradation mixing with required optimum quantity of water incl material, labour, plant and machinery and equipment etc. complete.**

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material premixed with water, a dense mass on a prepared sub grade / sub-base/base or existing pavement as the case may be in accordance with the requirements these Specifications. The material shall be laid in one or more layers necessary to lines, grades and cross- sections shown on the approved drawings or directed by the Engineer.

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 increased to 200 mm upon approval of the Engineer.

**Materials:**

**Aggregates:**

**Physical requirements:**Coarse aggregates shall be crushed stone. If crushed gravel/ shingle is used, not less than 90 percent by weight of the gravel/ shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table - 1 below.

**TABLE -1 PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE - BASE COURSES**

Test	Test Method	Requirements
1	Los Angeles Abrasion value or Aggregate Impart value	IS-2386 (Part-4) IS-2386 (Part-4) or IS 5040
2	Combined Flakiness and Elongation index (Total	IS:2380(Part-4) or IS 5040 IS: 2380 (Part-1)

Aggregate may satisfy requirements of either of the two tests.

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

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).

**Grading requirements:** The aggregates shall conform to the grading given in Table -2

**TABLE -2 GRADING REQUIREMENT OF AGGREGATES FOR WET MIX MACADAM**

IS Sieve Designation	Percent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60

4.75 mm	15-30
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

The material finer than 425 micron shall have plasticity Index (PI) not exceeding 6.

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

### **3.0 Construction Operations**

#### **3.1 Preparation of base:**

The surface of the subgrade/sub-base /base to receive the WMM course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to I.R.C. Clause 501.

As far as possible, laying WMM course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, WMM can be laid over the existing thin bituminous surface by cutting 50 mm X 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one meter intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

**3.2 Provision of lateral confinement of aggregates:** While constructing wet mix macadam, arrangement shall be made for the lateral IRC confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described Clause I.R.C. 407.4.1.

**3.3. 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 force positive mixing arrangement quantity of wet mix works, the Engineer may permit the mixing to be done in concrete mixers. Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part - S) 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. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

**3.4 Spreading of mix:** Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base in required quantities. In no case should 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 either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finish shall be self- propelled, having the following features:

Loading hoppers and suitable distribution mechanism

The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.

The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface blemishes. 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 large and fine particles should be allowed. The aggregates as spread should be of uniform gradations with no pockets of fine materials.

**3.5 Compaction:** After the mix has been laid to the required thickness, grade and cross fall / 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 upto 200 mm. the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. 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.

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, wall 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 subgrade is soft or yielding or when it causes a wave like motion in the sub-base /base course or sub grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as achieve a uniform surface conforming to the desired grade and crossfall. In no case should 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 outlines in IS:2820 (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 re compacted.

### **3.6 Important Considerations in Construction Process**

While due care and attention is required on the whole process of WMM construction, the following are important points needing more attention:-

Sometimes because of moisture in the fines, these will not flow out from the bin of the three-bin feeder to the belt. In such situation, it would be necessary to have a small vibrator fitted on one of the side walls of the bin to intermittently shake it.

Control on water in the mix is of utmost importance; hence there should not be any variation in the grading, particularly of fines as it will affect the moisture content and uniform mixing. Similarly, excessive fluctuations in the moisture content of the fines should be avoided. If necessary, slight increase may be made in the moisture contents to account for the moisture loss in transit to the laying site.

Excessive silt or clay in fines should not be permitted, as besides spoiling the quality of mix, it will cause clogging in pugmill and storage silo.

The mixed material should be transported directly to site. Stockpiling of mixed material should be discouraged as excessive handling is the cause of segregation and moisture loss, both of which are detrimental to the quality of the wet mix macadam.

There should be minimum joints in laying wet mix macadam. To ensure this, the daily output should at least be 500 linear meters. The width of laying also should be so adjusted to avoid the necessity of laying narrow strips e.g. against kerbs.

Single paver of 7m width or two pavers each of 3.5m width working in tandem within the short distances should be used for obtaining good results.

### **3.7. CONSTRUCTION PROCESS**

The construction process of wet mix macadam involves the following sub-activities:-

Production of aggregates in required sizes.

Proportioning of aggregates and mixing with water.  
Transportation of mix.  
Spreading and laying.  
Compaction.

The whole process should be such that methods adopted and equipment used meet the laid down requirements of end result specifications in respect of sizes and grading of aggregates, optimum moisture content, proper mixing, laying in uniform thickness to the correct profile and required compaction.

### **3.8 PROPORTIONING OF AGGREGATES AND MIXING**

Proportioning and mixing can be done in different ways depending on the total methodology of work adopted.

#### **3.8.1 Concrete Mixer**

For small quantities of WMM, concrete mixer can be used for production of mix and different fractions can be added by box measurement as in the case of manual feeding of mixer for producing concrete. In this method, the usual facility of measuring water is overhead tank which will not be very accurate. Further, because of limitations such as the size and capacity of mixer, manual feeding and non –continuous production of mix makes, this method is unsuitable for large scale work.

#### **3.8.2 Batching and Mixing Plant**

3.8.2.1 In order to obtain uniform WMM material using batch plant, only pan type mixing plant should be used, since it provides the force mixing of the different constituents of the mix. The mixing time may have to be increased for more uniform dispersal of low water content in the mix. Blending of aggregates and mixing can be achieved through storage bins and weigh hoppers.

#### **3.8.3 Bin feeder & pugmill**

For continuous production of mix in a pugmill in sufficient quantity, the best way to feed the aggregates and control the grading is by means of a 3 or 4 bins feeder with belt conveyor. It is similar to the bin feeder of a hot mix plant but without variable speed motors and load sensor as the required grading can be achieved with the adjustment of gate openings itself. Such a unit consisting of 3 or 4 bins feeder, belt conveyors, pugmill and water pump arrangement is the most suitable equipment for production of wet mix macadam.

**3.9 Important features:** The following are some of the important features to be kept in view:

Under each bin, there should be an adjustable quadrant gate and belt feeder to regulate the aggregate supply. Giggli screen should be provided over the coarse aggregate bins to exclude oversize material, if any.

A surface vibration should be provided on the outside of the sand/fines bin to maintain uniform flow. Belt feeder, gathering conveyors and secondary conveyor should have independent motors.

The angle of inclination of secondary conveyor should not be more than 19 degrees. The twin-shaft pugmill should have replaceable inner liner plates.

The clearance between the tips of the paddles and liners should be less than maximum stone size so that the aggregates are pushed forward while mixing. This type of paddles should be adjustable so that clearance can be set according to maximum size of aggregate.

The mixing of aggregates and water is done in a continuous twin-shaft pugmill or paddle mixer. Unlike a drum mixer where mixing is achieved by rotation of the drum and flights inside it, there is forced action – mixing in a pugmill which is better for uniform coating of film of moisture. As such the use of Drum Mix Plant is not suitable for producing WMM. The controlled amount of water is added in the pugmill by a spray bar with the help of a variable speed pump and a flow meter. This arrangement provides a precise control on the quantity of water which is very critical for the success of WMM construction. In this method, feeding of aggregates, addition of water and mixing are continuous operations. The mix can be either directly discharged into the tipping truck or taken through a belt conveyor to a storage silo. It is advantageous to have a storage silo, as it helps in continuous production of mix even

when no tipping truck is readily available for loading. Also loading of tipper through storage silo takes less time. Thus there will be saving in the number of tipping trucks required.

### **3.10 TRANSPORTATION**

Transportation of mix is usually done by tipping trucks. In order to avoid moisture loss in transit due to evaporation, mix should be covered with Tarpaulin.

### **3.11 SPREADING AND LAYING**

For this job, there are two clear alternatives in the choice of equipment. These are motor grader and paver finisher. Both these are suitable for the work.

**3.12 Setting and drying:** After final compaction of wet mix made course, the road shall be allowed to dry for 24 hours.

### **4.0 Opening to Traffic**

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

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

**5.1 Surface evenness:** The surface finish of construction shall conform to the requirements of Clause IRC-902.

The surface levels of a wet mix layer laid as a sub-base shall have a tolerance of not more than +10mm and -20mm from the designed longitudinal and cross profile. When laid as a base course with machines, the tolerance shall be +10mm and -10mm. For checking compliance with this, surface levels shall be taken on a grid of points placed 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 above tolerances, thus one measurement being not in excess of 5mm above the permitted tolerance.

5.2 The longitudinal profile shall also be checked by a 3 meter straight edge at the middle of each traffic lane parallel to the centre line of the road. The maximum allowable difference between the road surface and underside of a 3 meter straight edge shall be 8 mm.

**5.3 Quality Control:** Control on the quality of materials and works shall be exercised by the Engineer in accordance with IRC Section 900.

5.4 The frequency of the Quality Control tests shall be as under:-

Gradation One Test per 100 m<sup>3</sup>

Plasticity Index One test per 200 m<sup>3</sup>

Moisture Content prior to compaction One test per 250 m<sup>2</sup>

Density of compacted layer One test per 500 m<sup>2</sup>

Aggregate Impact Value or Los Angeles Abrasion Value One test per 200 m<sup>3</sup>

Flakiness and Elongation Index One test per 200 m<sup>3</sup>

**5.5** For testing the compaction requirements, test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of 5-10 density determinations. The number of tests in one set of measurements shall be 6 (if non-destructive tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over the constituent materials forming the mix is being exercised. If considerable variations i.e. 15% and above are observed between individual density results, the minimum number of tests in one set of measurements shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density of a set of measurement shall not be less than the specified density plus.

$$1.65 - \frac{1.65}{\sqrt{(\text{No. of samples})}} \times \text{standard deviation}$$

### **6.0 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 sub grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over

The affected area, reshaped with added premixed material or removed and replaced with fresh premixed materials applicable and re-compacted in accordance with IRC Clause 406.3. 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.

#### **7.0 Arrangement for Traffic**

During the period of construction, arrangement of traffic shall be done as per IRC Clause 112.

#### **8.0 Measurements for Payment**

Wet mix macadam shall be measured as finished work in position in cubic metres.

#### **9.0 Rates**

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

### **Item No 8 -Providing and applying primer coat with bitumen emulsion SS1 on prepared surface of granular Base including clearing of road surface and spraying primer at the rate of 0.85 kg/sqm using mechanical means.**

Providing & applying bitumen emulsion coat at the rate of 8.5 kg / 10m<sup>2</sup> of road area with bitumen emulsion (SS1 grade ) complying IS 8887 as per MORT&H over prepared surface of wet mix base including spraying uniformly by using self-propelled or towed bitumen pressure sprayers equipped for spraying the material uniformly at specified rates and temperature with self-heating arrangement, heating the bitumen, cleaning the road surface as per MORT&H specifications etc. complete including all labor charges and cost of all materials involved in the work , transportation charges, material testing charges and incidental charges as directed etc complete.

**Scope:** This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

#### **Materials**

**Primer:** Primer shall be bitumen emulsion of SS-1 grade complying with IS 8887

#### **Primer viscosity:**

The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with the standards. Guidance on viscosity and rate of spray is given in Table 500-1.

**TABLE 500-1. VISCOSITY REQUIREMENT AND QUANTITY OF LIQUID BITUMINOUS PRIMER**

Type of Surface	Kinematic Viscosity of Primer at 60o C ( Centistokes )	Quantity of Liquid Bituminous Material per 10 Sq.M. (kg)
Low porosity	30 – 60	6 to 9
Medium porosity	70 – 140	9 to 12
High porosity	250 – 500	12 to 15

### **3.Weather and Seasonal Limitations**

Bituminous primer shall not be applied to a wet surface (see 502.4.2) or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10o C. Surfaces which are to receive emulsion primer should be damp. But no free or standing water shall be present.

#### **Construction**

##### **4.1. Equipment:**

The Primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small areas. Inaccessible to the distributor, or as directed by the Engineer.

**4.2 Preparation of road surface:**The surface to be primed shall be prepared in accordance with Clauses 501.8.

**501.8** This work shall consist of preparing an existing granular surface and shall be performed on such widths and lengths as shown on the drawing or as directed by the Engineer

Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the inter locked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

**4.3 Application of emulsion bituminous primer:**The rate of application of the primer shall be at rate of 8.5 Kg / 10 Sq.m. or as directed. The bituminous primer shall be sprayed uniformly in accordance with Clause 501. 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.

**4.4 Curing of primer and opening to traffic:**A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an 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. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

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

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 901 of MORT & H specifications shall apply.

#### **Arrangements for Traffic**

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112 of MORT & H specifications.

#### **Measurement for Payment**

Prime coat shall be measured in terms of surface area of application in square meters.

#### **Rate:-**

The contract unit rate for prime coat with adjustments as described in Clause 502.7 of MORT&H specification shall be payment in full for carrying out the required operations including full compensation for all components listed below

[i] Making arrangements for traffic to Clause 112 as above except for initial treatment to verges, shoulders and construction of diversions.

[ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.

[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 8.5 kg per 10 square meter, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials referred to in Clause 502.4.3. of MORT&H specification stated above.

#### **Item No 9: DBM-60 mm**

**Providing & laying compacted 60 mm thick dense graded bituminous macadam (DBM) Grade-II in Single layer using 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour, tack coat at**

the rate of 2.5 kg / 10 m<sup>2</sup> (VG10) in each using crushed aggregates of specified grading . premixed with bituminous binder @ 4.5% ( VG - 40) by weight of total mix and filler , transporting the hot mix to work site laying with a hydrostatic paver finisher with sensor control with minimum road width or as directed by Engineer in charge to the required grade, level and alignment, rolling with smooth wheeled vibratory and tandem rollers to acheive the desired compaction as per MORT&H specification etc complete in all respects. The agency shall have to get the mix design done from approved laboratory and submit to the Engineer in charge for approval. If the asphalt (bituminous) content is more than above, the agency shall have to bear the cost of additional asphalt. The payment shall be done on the permissible field density achieved on the site instead of density derieved in the mix design. ( The density obtained by mix design above 2.31 MT/M3 shall be boarn by agency )

### 1.0 Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. DBM is also intended for use as road base material. This 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 50mm to 100mm.

Note: Agency to ensure that  $V_a = 3.50\%$  &  $V_{be} = 11.50\%$

### 2.0 Materials

**2.1. Bitumen:** The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, and of the penetration indicated in Table 500-10 for dense bitumen macadam

**2.2. Coarse aggregates:** The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated- with an approved anti-stripping agent, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in Table 2.2-1, for dense bituminous macadam.

Where crushed gravel is proposed for use as aggregate, not less than 90% by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

**2.3. Fine aggregates:** Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

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 2.2-1. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR DENSE GRADED BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness(dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30%
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 35%
	Aggregate Impact Value <sup>4</sup>	Max 27%
Durability	Soundness: <sup>5</sup>	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%



Water Absorption	Water absorption <sup>6</sup>	Max 2%
Stripping	Coaling and Stripping of Bitumen Aggregate Mixtures <sup>7</sup>	Minimum retained coating 95%
Water Sensitivity <sup>**</sup>	Retained Tensile Strength <sup>8</sup>	Min 80%

Notes :1. IS : 2386 Part 1 5. IS : 2386 Part 5

IS : 2386 Part 1 6. IS : 2386 Part 3

(the elongation test to be done only on non-flaky aggregates in the sample)

IS: 2386 Part 4\* 7. IS: 6241

IS: 2386 Part 4\* 8. AASHTOT283<sup>\*\*</sup>

Aggregate may satisfy requirements of either of these two tests.

<sup>\*\*</sup> The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

**2.4. Filler:** Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer.

The filler shall be graded within the limits indicated in Table 2.4-1

**TABLE 2.4-1. GRADING REQUIREMENTS FOR MINERAL FILLER**

IS Sieve (mm)	Cumulative per cent passing by weight of total aggregate
0.6	100
0.3	95-100
0.075	85-100

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 per cent by weight of total aggregate, shall be Portland cement or hydrated lime and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the limestone aggregate is used. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

**2.5. 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 added filler for the particular mixture shall fall within the limits shown in Table 2.5-1, for dense bituminous macadam grading 1 or 2 as specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

**TABLE 2.5-1. COMPOSITION OF DENSE GRADED BITUMINOUS MACADAM PAVEMENT LAYERS**

Grading	1	2
Nominal aggregate size	40mm	25mm
Layer Thickness	80-100 mm	50-75 mm
<b>IS Sieve<sup>1</sup> (mm)</b>	<b>Cumulative % by weight of total aggregate passing</b>	
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	--	--
0.6	--	--
0.3	7-21	7-21
0.15	--	--
0.075	2-8	2-8
Bitumen content % by mass of total mix <sup>2</sup>	Min4.0	Min4.5
Bitumen grade (pen)	65 or 90	65 or 90

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

Determined by the Marshall method.

### 3.0 Mixture Design

**3.1. Requirement for the mixture:** Apart from conformity with the grading and quality requirements for individual ingredient the mixture shall meet the requirements set out in Table 3.1-1.

**TABLE 3.1-1. REQUIREMENTS FOR DENSE GRADED BITUMINOUS MACADAM**

Minimum stability (KN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-6
Percent voids in mineral aggregate (VMA)	See Table 500-12 below.
Per cent voids filled with bitumen (VFB)	65-75

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 3.1-2.

**TABLE 3.1-2. MINIMUM PER CENT VOIDS IN MINERAL AGGREGATE (VMA)**

Nominal Maximum Particle Size <sup>1</sup> (mm)	Minimum VMA, Per cent Related to Design Air Voids, Per cent <sup>2</sup>		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Notes: 1. The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent.

Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.

**3.2. Binder content:** The binder content shall be optimized to achieve the requirements of the mixture set out in table 3.1-1 and the traffic volume specified in the Contract. The Marshall method for determining the optimum

binder content shall be adopted as described in The Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve by the aggregates passing the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

Where 40 mm dense bituminous macadam mixture is specified, the modified Marshall method described in MS-2 shall be used. This method requires modified equipment and procedures; particularly the minimum stability values in Table 3.1-1 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**3.3. Job mix formula:** The Contractor shall inform the Engineer in writing, at least 20 days before the start of the work, of the job mix formula proposed for use in the works, and shall give the following details:

Source and location of all materials:

Proportions of all materials expressed as follows where each is applicable:

Binder type, and percentage by weight of total mixture;

Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;

A single definite percentage passing each sieve for the mixed aggregate:

The individual grading of the individual aggregate fractions, and the proportion of each in the combined grading.

The results of tests enumerated in Table 3.1.1 as obtained by the Contractor;

Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch.

Test results of physical characteristics of aggregates to be used;

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 mixture 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 to the Engineer for approval before the placing of the material.

**3.4. Plant trials - permissible variation in job mix formula:**

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials at the mixer to establish that the plant can be set up to 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 3.4-1.

**TABLE 3.4-1. PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA**

Description	Permissible variation	
	Base/binder course	Wearing coarse
Aggregate passing 19nun sieve or larger	±8%	±7%
Aggregate passing 13.2mm, 9.5mm	±7%	±6%
Aggregate passing 4.75mm	±6%	± 5%
Aggregate passing 2.36mm, 1.18mm, 0.6mm	±5%	±4%
Aggregate passing 0.3mm, 0. 15mm	±4%	±3%
Aggregate passing 0.075mm	±2%	± 1.5%
Binder content	±0.3%	±0.3%
Mixing temperature	±10°C	±10°C

Once the plant trials have demonstrated the capability of the plant, and the trials are approved, the laying operation may commence. Over the period of the first month of production for laying on the works, the Engineer shall require additional testing of the product to establish the reliability and consistency of the plant.

**3.5. Laying Trials:** Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid, and compacted all in accordance with Clause 3.5.1. The laying trial shall be carried out on a suitable area which is not to form part of the works, unless specifically approved in writing, by the Engineer. The area of the laying trials shall be a minimum of 100 sq.m. of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

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 centre longitudinally except that on super elevated and unidirectional cambered portions, it shall progress from the lower to the upper edge parallel to the centre 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 tonnes dead weight smooth-wheeled rollers. The intermediate rolling shall be done with 8-10 tonnes dead weight or vibratory roller or with a pneumatic tyred roller of 12 to 15 tonnes weight having nine wheels, with a tyre pressure of at least 5.6 kg/sq.cm. The finish rolling shall be done with 6 to 8 tonnes smooth wheeled tandem rollers.

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 nominate 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 real roll or, in the case of a pneumatic-tyred roller, at least the nominal width of 300mm

In portions with super-elevated and uni-directional 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 or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of rollers shall be kept moist with water, and the spray system provided with the machine shall be in good working order, to prevent the mixture from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mixture should be used. Surplus water shall not be allowed to stand on the partially compacted pavement

### **Construction Operations**

**4.1: Weather and seasonal limitations:** Laying shall be suspended while free-standing water is present on the surface to be covered, or during rain, fog and dust storms. After rain, the bituminous surface, prime or tack coat, shall be blown off with a high pressure air jet to remove excess moisture, or the surface left to dry before laying shall start. Laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10°C or when the wind speed at any temperature exceeds 40 km/h at 2m height unless specifically approved by the Engineer.

**4.2. Preparation of base:** The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where-mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

**4.3. Stress absorbing layer:** Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements.

**4.4. 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 The primer shall be bitumen emulsion, complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of medium curing cutback as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

**4.5. Tack coat:** The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer.

The use of cutback bitumen, as per IS 217 shall be restricted only for sites at sub-zero for emergency applications as directed by the Engineer.

**4.6. Mixing and transportation of the mixture:**

**4.6.1 Mixing**

Pre-mixed bituminous materials, including bituminous macadam, dense bituminous macadam, semi-dense bituminous concrete and bituminous concrete, 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 500-5 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.

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.

**4.6.2 Transporting**

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.

**4.7 Spreading:** Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machine. 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, 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 where a mechanical paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by experienced staff, and compacted to the satisfaction of the Engineer.

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 300mm 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 waterproofing systems, unless precautions against heat damage have been approved by the Engineer

Hand placing of pre-mixed bituminous materials shall only be permitted in the following circumstances:

For laying regulating courses of irregular shape and varying thickness.

In confined spaces where it is impracticable for a paver to operate.

For footways.

At the approaches to expansion joints at bridges, viaducts or other structures.

For laying mastic asphalt in accordance with Clause 515.

For filling of potholes.

Where directed by the Engineer.

Manual spreading of pre-mixed wearing course material or the addition of such material by hand-spreading to the paved area, for adjustment of level, shall only be permitted in the following circumstances:

At the edges of the layers of material and at gullies and manholes.

At the approaches to expansion joints at bridges, viaducts or other structures.

As directed by the Engineer.

**Cleanliness and overlaying:** 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 Clause 501.8.

Binder course material shall not remain uncovered by either the wearing course or surface treatment, whichever is specified in the Contract, for more than three consecutive days after being laid. The Engineer may extend this period, by the minimum amount of time necessary, because of weather conditions or for any other reason. If the surface of the base course is subjected to traffic, or not covered within three days, a tack coat shall be applied, as directed by the Engineer.

**4.8. Rolling:** The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

#### **5.0. Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hrs after laying and completion of compaction, without the express approval of the Engineer in writing.

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

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after:

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 6.0-1.

**TABLE 6.0-1. TOLERANCES IN SURFACE LEVELS**

1. Subgrade	+ 20 mm - 25mm
Sub-base + 10 mm	
Flexible pavement	-20mm
Concrete pavement	+ 6 mm
[Dry clean concrete or Rolled concrete]	-10mm
Base-course for flexible pavement	
Bituminous course	+6 mm
Other than bituminous	-6mm
Machine laid	+10mm
(ii) Manually laid	-10mm
	+ 15 mm
	-15 mm
Wearing course for flexible pavement	+ 6 mm
Machine laid	- 6mm

(b) Manually kid	+ 10mm - 10mm
5. Cement concrete pavement	+ 5 mm -6mm*

This may not exceed - 8 mm at 0 - 30 cm from the edges.

## 7.0 Arrangements for Traffic

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of. traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased program for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

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 to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

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 signs as approved by the Engineer 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 120m away. The signs shall be of approved design and of reflectory type, if so directed by the Engineer.

## 8.0 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work in Metric tonne.

### 9.0 Rate

The contract unit rate for Dense Bituminous Macadam shall be payment in full for carrying out the all required operations as specified. The rate shall include the provision of bitumen, at 4.5 per cent by weight of the total mixture.

### Item No 10 BC -40 mm

**Providing and laying 40 mm Thick Bituminous Concrete using crushed stone aggregate BT chips as per required gradation and using emulsion asphalt as a tack coat @ 2.5 kg / 10 sq.m (VG 10) and the VG-40 grade asphalt at 5.40 % by total weight of mix hot laid process using 100-120 TPH batch type hot mix plant producing an average output of 75 tonnes per hour incl. transporting the mix and laying by hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem roller to achieve the desired compaction as per MoRT&H specifications clause 509 complete including cost of material labour machinery equipment and fuel, oil. Lubricant for plant and machinery using contractor's own plant and machinanes etc complete. The agency shall have to get the mix design done from approved laboratory and submit to the Engineer in charge for approval. If the asphalt (bituminous) content is more than above, the agency shall have to bear the cost of additional asphalt. The payment shall be done on the permissible field density achieved on the site instead of density derieved in the mix design. ( The density obtained by mix design above 2.36 MT/M3 shall be boarn by agency )**

This work shall consist of construction in a single layer of dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 40mm in thickness.

Note: Agency to ensure that  $V_a = 3.50\%$  &  $V_{be} = 11.50\%$

## **Materials:-**

### **2.1 Binder:-**

The binder shall be a penetration bitumen of 60/70 (VG-40) grade as specified in the contract satisfying the requirement of IS : 73

### **2.2 Coarse aggregates:-**

The coarse aggregates shall consist of crushed rock retained on the 2.36 mm sieve. They shall be clean, hard, durable of cubical shape, free from dust and set of friable matter, organic or other deleterious matter. Where the contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents as per the manufacturer's recommendations, without additional payment. Before approval of the source the aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness	Max. 12%
	Sodium Sulphate	
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 1%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

## **Notes :-**

[1] IS : 2386 Part – 1 [2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample] [3] IS : 2386 Part – 4 [4] IS : 2386 Part – 5 [5] IS : 2386 Part – 3 [6] IS : 6241 [7] The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95 %

Aggregate may satisfy requirements of either of these two tests.

### **2.3 Fine aggregates:-**

The Fine aggregates shall consist of crushed rock, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, uncoated mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious matter.

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)

**2.4 Filler:** -Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer.

The filler shall be graded within the limits indicated in Table 500-9

TABLE 500-9. GRADING REQUIREMENTS FOR MINERAL FILLER



IS Sieve (mm)	Cumulative percent passing by weight of total aggregate.
0.6	100
0.3	95 - 100
0.075	85 - 100

The Filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 percent by weight of total aggregate, shall be Portland cement or hydrated lime and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the limestone aggregate is used. Where the aggregate fail to meet the requirements of the water sensitivity test in Table 500-8 then 2 percent by total weight of aggregate, of hydrated lime shall be added without additional cost.

### **2.5 Aggregate grading and binder content:-**

When tested in accordance with IS :2386 Par I (wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-15 for grading II as specified in the contract.

**Table 500.15 Composition of Semi Dense Bituminous Concrete Pavement Layers**

<b>Grading</b>	<b>2</b>
<b>Nominal aggregate size</b>	<b>10 mm</b>
<b>layer thickness</b>	<b>25 mm</b>
<b>IS : Sieve [MM]</b>	<b>Cumulative % by weight of total aggregate passing.</b>
13.2	100
9.5	90 - 100
4.75	35 - 51
2.36	24 - 39
1.18	15 - 30
0.6	-
0.3	9 - 19
0.15	-
0.075	3 - 8
Bitumen content % by weight of total mixture	5.40
Bitumen Grade	60/70 (VG-40)

Note: 1 The combined aggregate grading shall not vary from the below limit on one sieve to the high limit on adjacent sieve.

2 Determined by the marshal method

The quantity of binder used for premixing in terms of straight run bitumen 60/70 grade shall be 5.4% by weight of total mix.

### **Mixture Design**

#### **Requirements for the mixture:**

Apart from conformity with the grading and quality requirements for individual ingredients the mixture shall meet the requirements set out in Table 500 -16

**Table 500-16. Requirements for Semi Dense Bituminous Pavement Layers**

Minimum stability (kn at 600C	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of

	the specimen
Per cent air voids	3.5
Per cent voids in mineral aggregate (VMA)	See table 500-12
Per cent voids filled with bitumen (VFB)	65 - 78

Note: Agency to ensure that  $V_a = 3.50$  &  $V_{be} = 11.50$

**Table 500-12. Minimum per cent voids in mineral aggregate (VMA)**

Nominal Maximum particle Size (mm)	Minimum VMA, per cent related to Design Air Voids, Per cent		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Notes: 1 The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent.

Interpolate minimum voids in the mineral aggregate (VMA) for design air voids value between those listed.

#### **Binder Content**

The binder content shall be optimized to achieve the requirements of the mixture set out in Table 500-16 and the traffic volume as specified in the contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

#### **Job mix formula**

The contractor shall inform the Engineer in writing, at least 20 days before the start of the work, of the job mix formula proposed for use in the works, and shall give the following details;

Source and location of all materials;

Proportion of all materials expressed as follows where each is applicable;

Binder type, and percentage by weight of total mixture;

Coarse aggregate/ Fine aggregate/ Mineral filler as percentage by weight of total aggregate including mineral filler;

A single definite percentage passing each sieve for the mixed aggregate;

The individual grading of the individual aggregate fractions and the proportion of each in the combined grading.

The results of tests enumerated in Table 500-16 as obtained by the contractor.

Where the mixture is a batch mixer, the individual weight of each type of aggregate, and binder per batch,

Test results of physical characteristics of aggregates to be used;

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 mixture 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 supply of materials be proposed, a new job mix formula shall be forwarded 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 trials at the mixer to establish that the plant can be set up to produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentage 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 500-13. These variations are intended to apply to individual specimens taken for quality control tests in accordance with section 900.

**Table 500-13. Permissible Variations from the Job Mix Formula**

Description	Permissible variation	
	Base/binder course	Wearing course
Aggregate passing 19mm sieve or larger	+ 8 %	+ 7 %
Aggregate passing 13.2mm, 9.5mm	+ 7 %	+ 6 %
Aggregate passing 4.75	+ 6 %	+ 5 %
Aggregate passing 2.36mm, 1.18mm, 0.6mm	+ 5 %	+ 4 %
Aggregate passing 0.3mm, 0.15mm	+ 4 %	+ 3 %
Aggregate passing 0.075mm	+ 2 %	+ 1.5 %
Binder content	+ 0.3 %	+ 0.3 %
Mixing temperature	+ 10° C	+ 10°C

Once the plant trials have demonstrated the capability of the plant, and the trials are approved, the laying operation may commence. Over the period of the first month of production for laying on the works, the Engineer shall require additional testing of the product to establish the reliability and consistency of the plant.

**Laying Trials:**

Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid and compacted all in accordance with Clause 501. The laying trial shall be carried out on a suitable area which is not to form part of the works, unless specifically approved in writing, by the Engineer. The area of the laying trials shall be a minimum of 100 sq.m. of construction similar to that of project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

**Construction Operations:-**

The provision of following Clauses shall apply.

**Weather and seasonal limitations: -**

Laying shall be suspended while free standing, water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10° C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

**Preparation of base:-**

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clause 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In location where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

**Mixing and transportation of the mixture. :-**

The provisions as specified in Clause 501.3 and 501.4 shall apply

**Clause 501.3 Mixing:**

Pre-mixed bituminous materials including semi dense bituminous concrete, 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 shall be as per Table 500-5

**Table 500.5 Manufacturing and Rolling Temperatures.**

Penetration	Bitumen Mixing [C]	Aggregate Mixing [C]	Mixed Material [C]	Rolling [C]	Laving [C]
35	106-170	160-175	170 Maximum	100 Maximum	130 Maximum
65	150-165	150-170	165 Maximum	90 Maximum	125 Maximum
90	140-160	140-165	155 Maximum	80 Maximum	115 Maximum

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 aggregate, the hot mix plant shall be calibrated from time to time.

**Clause 501.4: Transporting**

Bituminous material 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 premixed material shall be spread by suitable means to the desired thickness grades and cross-fall. Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machine. 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 paver, and its method of operation, 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 where a mechanical paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by experienced staff, and compacted to the satisfaction of the Engineer.

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 300mm 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 waterproofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre-mixed bituminous materials shall only be permitted in the following circumstances:

For laying regulating courses of irregular shape and varying thickness.

1 In confined spaces where it is impracticable for a paver to operate.

2 For footways,  
3 At the approaches to expansion joint at bridges, viaduct or other structures,  
For filling of pot holes  
Where directed by the Engineer.

Manual spreading of pre-mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level, shall only be permitted in the following circumstances:

At the edges of the layers of material and at gullies and manholes

At the approaches to expansion joints at bridges, viaducts or other structures.

As directed by the Engineer.

#### **4.5 Rolling:**

As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8-10 tonne rollers smooth wheel tandem type or other approved equipment. Rolling shall begin at the edge and progress toward the center longitudinally except that on superelevated and unidirectional cambered portions it shall progress from the lower to upper edge parallel to the center line of the pavement.

When the roller has passed over the whole area once any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and all the roller marks eliminated. In each pass of the roller the proceeding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels. In no case shall fuel, lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided.

Rollers shall not stand on newly laid material. Rolling operations shall be completed in every respect before the temperature of the mix falls below the minimum rolling temperature stated in the relevant part of these Specifications. Joints along and transverse to the surfacing laid and compacted earlier shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin coat of appropriate binder before the new mix is placed against it.

#### **Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

#### **Surface Finish and Quality Control**

The surface finish of the completed construction shall conform to the requirements of Clause 902 of MORT & H Specification. All materials and workmanship shall comply with the provisions set out in Section 900 of MORT & H Specification.

#### **Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112 of MORT&H Specifications.

#### **Measurement for Payment:-**

The payment shall be made on the tonnage basis of the weight of mix aggregates and bitumen. For this purpose, the contractor shall have to install a weigh-bridge of suitable capacity for the purpose of weighing dumpers at suitable place at his cost as directed. Weight of empty dumpers and weight of loaded dumper will be recorded in bound and numbered register on plant site.

Department will be free to get some loaded dumpers test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field then the reduction in or addition to payment shall have to be effected to the contractor on pro-rate basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so authorized. Record of each dumper will be mentioned separately in bond

and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometre and meter in which individual dumpers are unloaded shall be recorded carefully.

**508.9 Rate for premixed bituminous materials:** - The contract unit rate shall be for all as specified in clause 507.9 except that the rate shall include the provision of bitumen at 5.4 % by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly. The unit rate for premixed bituminous material shall be payment in full for carrying out the required operation including full compensation for, but not limited to:

Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.

Preparation of the surface to revive the materials.

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. Mixing transporting, laying and compacting the mix as specified. All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification. Carrying out the work in part widths of the road where directed.

Carrying out all tests for control of quality, and The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly. The rate for premixed material are to include for all wastage in cutting of joints etc. The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.

The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials.

## **Item no 11.**

**Providing and applying asphalt painting with bitumen of VG 40 grade on bituminous surface including clearing of road surface and spraying Bitumen at the rate of 0.60 kg / sqm using mechanical means.**

### **1 Scope:-**

This work shall consist of the application of a single coat of bitumen 60/70 (VG-40)grade to an existing bituminous road surface in accordance with the following specifications.

### **2 Materials:-**

**2.1 Bitumen:-**The bitumen used for asphalt painting shall be 60/70 (VG-40) grade complying with IS: 73 or as directed by the Engineer.

### **2.2 Stone Dust:-**

**2.2.1.** This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under:

**2.2.2.** A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

**2.2.3.** The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

**2.2.4.** The fineness modules of stone dust shall not be less than 1.80

### **3 Weather and Seasonal Limitations:-**

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 100 C.

### **4 Construction:-**

#### **Equipment:-**

The asphalt painting shall be applied through a distributor and it shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate, hand spraying of small areas, inaccessible to the distributor in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

#### **Preparation of base:-**

The surface on which the asphalt painting is to be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements of Clauses-501.8 & 513 of MORT & H as appropriate. Immediately before the application of the asphalt painting 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 asphalt painting:-**

The application of asphalt for painting shall be at 6.0 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be heated in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150°C -177°C.

The method of application of the tack coat 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 a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

### **5.0 Spreading of Stone Dust & rolling.**

Soon after the spraying of asphalt, the stone dust shall be spread evenly with a twisting motion of baskets at the rate of 0.013Cum/10 Sqm. The entire surface shall be broomed to ensure uniform application of the stone dust. The surface shall be rolled with pneumatic tyred roller as directed by the Engineer in charge. While the traffic is allowed on the painted surface and at later stage if additional stone dust is required, it shall be carried out by the contractor without any extra payment.

### **6.0 Opening to Traffic:-**

Traffic may be allowed immediately after completion of flushing of stone dust on asphalt painted surface and rolling with PTR roller is completed.

### **7.0 Arrangement of Traffic:-**

The provision of MOST Specification Clause 112 shall apply as regards the flow of traffic during construction.

### **8.0 Mode of Measurement & Payment:**

The Item shall be measured and paid as finished work in Square meters. The rates shall include the cost of all materials, labour, equipments etc. involved in all the operations described above. The rate shall be for a unit of one sq. meter.

### **Item No. 12: Hot Applied Thermoplastic Patta:**

Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide luminance coefficient on cement road shall be min 130 mcd/m<sup>2</sup>/lux and Asphalt road shall be min 100 mcd/m<sup>2</sup>/lux during the service life during the day time. The marking should meet the performance

**criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.**

**General :-**

**Hot Applied Thermoplastic Road Marking.**

The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.

The Thermoplastic compound shall be screened / extruded 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 be produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

The colour of the compound shall be white or yellow (IS : colour No. 356) as specified in drawings or as directed by the Engineer.

Where the compound is to be applied to cement concrete pavement sealing primer as recommended by the manufacture, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and / or curing compound shall be removed before the marking are applied.

**THERMOPLASTIC MATERIALS**

**GENERAL:**

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

**REQUIREMENT:**

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 800 – 3.

Table 800 – 3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL (percentage by weight )

Component	White	Yellow
Binder	18.00 min.	18.00 min.
Glass Beads	30 – 40	30 – 40
Titanium Dioxide	10.00 min.	- - -
Calcium Carbonate and Inert Fillers	42.00 max	See Note
Yellow Pigments	- - -	- do -

Note: Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provide all other requirement of this Specification are met.

II Properties : The properties of thermoplastic material, when tested in accordance with ASTM D36/ BX-3262- (Pa. T1) shall be as below :

**Luminance:**

White: Daylight luminance at 45 degree 65 per cent min. as per AASHTO M 249.

Drying time : When applied at a temperature specification by the manufactures and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

Skid resistance : not less than 45 as per BS 6044.

Cracking resistance at low temperature : The material shall show no cracks on application to concrete blocks.

Softening point : 102.5 ÷ 9.5” as per ASTM D 36.

Flow resistance : Note more than 25 per cent as per AASHTO M 249.

Yellowness index (for white thermoplastic paint) not more than 0.12 as per AASHTOM 249.

III Storage life : The materials shall meet the requirement of there Specifications for period of one year. The thermoplastic material must also melt uniformly with no evidence of skins of un-melted particles for 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 Clause 803.4.3 of MORT & H Specification.

V Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information.

The name, trademark or other means of identification of manufacturer.

Batch number.

Date of manufacture.

Colour (White or Yellow)

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 report from the manufacturer of the thermoplastic material showing results of all tests specified therein and shall certify that the materials meets all requirements of this Specification.

#### **REFLECTORIZING GLASS BEADS**

GENERAL : This Specification covers two types of glass beads to be used for to production of reflectorized pavement markings. Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800 – 3 and type – 2 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

The glass beads shall be transparent, colourless and free from milliness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in clause 5.4.3.3.

#### **SPECIFIC REQUIREMENTS.**

##### **A GRADATION :**

The glass beads shall meet the gradation requirements for the two types as given in Table 800 – 4

TABLE 800-4 GRADATION REQUIREMENT FOR GLASS BEADS

Sieve Size	Per Cent Retained	
	Table – 1	Table – 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 15

##### **B. ROUNDNESS:**

The glass beads shall have a minimum of 70 per cent true spheres.

##### **C. REFRACTIVE INDEX:**

The glass beads shall have a minimum refractive 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 condition suitable for paints striping. They shall pass the free flow-test.

##### **TEST METHODS:**

The specific requirement shall be tested with the following methods.

I Free-flow test: Spread 100grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccators plate with sulphur acid water solution (specific gravity 1.10) Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove Sample from desiccators, 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 6088 and BS 3262 (Part 1).

III The Contractor shall furnish to the Employer a copy of certified test report from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer in charge.

#### **APPLICATION PROPERTIES OF THERMOPLASTIC MATERIAL**

The thermoplastic materials shall readily get screed / 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 materials upon heating to application temperatures shall not exude fumes which are toxic. Obnoxious or injurious to persons or property.

#### **PREPARATION:**

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 materials 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 started by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic materials. Which has natural binders or is otherwise sensitive to prolonged heating the materials shall 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 MARKING:**

The stripe shall not be slippery when wet.

The marking shall not lift from the pavement in freezing weather.

After application and proper drying the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 C.

The marking shall not deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic. The stripe of 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 chipping or cracking.

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 requirements of Clause 5.3.

#### **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 requirements of Clause 5.3.

#### **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 materials shall be applied hot either by screening or 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 be less than 10 °C during application. All surface 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 bend itself to the old line that no splitting or separation takes place.

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 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 in 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.

#### MEASUREMENT FOR PAYMENT.

The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps, if any).

In respect of markings line directional arrows and lettering. Etc., the measurement shall be in Square meter basis.

#### Rate

The contractor unit rate for road markings shall be payment in full compensation of furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these specifications complete as per the approved drawing (s) or as directed by the Engineer and other incidental cost necessary to complete the work to these Specifications. Rate for this item shall be for sq. meters of actual area marked

#### Item 13:

**Cateyes Road Stud : Supplying of molded twin shanks raised pavement markers made of polycarbonate and ABS moulded body and reflective panels with micro prismatic lens [no glass bead lens] capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. 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 20 mm, 130 mm and with minimum reflective area of 13 sqm 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 +/- 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 manufacture's recommendation and the colour of the marker should be as per the IRC 35 2015 and as directed by Engineer in**

##### 1. General

Reflective Pavement marker (RPM) or road stud is 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.

## 2. Definitions

### Description of Terms Specific to this standard

- (a) 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 Milaca deal as per incident lux (med/ lx).
- (b) Horizontal entrance angle – the angle in the horizontal plant between the direction of incident light and the normal to the leading edge of the marker.
- (c) Observation angle – the angle in the reflector between the illumination axis and the observation axis.
- (d) Retro – reflection – reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over were variations of the direction of incident radiation.
- (e) Head – that part of a road stud which is above the road surface where the road stud is fixed in position in the road.
- (f) Upper surface – that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.
- (g) Anchorage – that part of a road stud which is below the road surface above the road stud is fixed position in the road.

## 3. Material

### Description of Terms Specific to this standard

- (a) 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 Milaca deal as per incident lux (med/ lx).
- (b) Horizontal entrance angle – the angle in the horizontal plant between the direction of incident light and the normal to the leading edge of the marker.
- (c) Observation angle – the angle in the reflector between the illumination axis and the observation axis.
- (d) Retro – reflection – reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over were variations of the direction of incident radiation.
- (e) Head – that part of a road stud which is above the road surface where the road stud is fixed in position in the road.
- (f) Upper surface – that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.
- (g) Anchorage – that part of a road stud which is below the road surface above the road stud is fixed position in the road.
- (a) Plastic body of RPM road stud shall be moulded from ASA (Acrylic Sterner Acrylonitrile) or HIPS (Impacts polystyrene) or ABS or any other suitable material approved by the Engineer-in-charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.

(b) Reflective panels shall consist if number of 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 ASTMD 788 or equivalent.

4. Design

Sq.cm.

(a) The slope or retro-reflecting surface shall preferably be 35 + 5 degree to base.

(b) The area of each retro-reflecting surface shall not be less than 13.0

5. Optical Performance

Unidirectional and bi-directional studs

(a) Each reflector or combination of reflectors on each face of the stud shall have a CIL 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 med 1 x		
		White	Amb er	Red
0" U 5" L & R	0.3"	220	110	44
0" U 10" L & R	0.5"	120	60	24

**Table 1 Minimum C.I.L. Values for Category "B" studs.**

Entrance angle	Observation angle	C.I.L. in med 1 x		
		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) 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 biconvex reflectors shall be considered to be included in category "B".

(b) Omni – directional studs: Each Omni-directional stud shall have a minimum C.I.L. of not less than med/ lx.

(c) Tests

Coefficient of luminance intensity can be measured by produced described in

ASTMD 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS 873 Part 4:1973. Under test conditions a stud shall

not be considered to fall the photometric requirements of the measured C.I.L. at

any one position of measurement is less than the values specified in Table 1 or 2 provided that.

- The value is not less than 80% of the specified minimum, and
- The average of the left and right measurements for the specific angle is greater than the specified minimum.

## 6. Fixing of Reflective Markers

### Requirements

- (a) The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.
- (b) The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.
- (c) All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.
- (d) Marker height shall not exceed 20 mm.
- (e) Marker width shall not exceed 130 mm.
- (f) The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

### Placement

- (a) The reflective marker shall be fixed to the road surface using the adhesives and the products recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.
- (b) 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 unit the surfacing has been opened to traffic for a period of not less than 14 hours.
- (c) The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.
- (d) Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.
- (e) The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.
- (f) 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 as necessary to remove adhesive from exposed faces of pavement marker.

## 7. Warranty and durability

The contractor shall obtain from the manufacturer a two-year warranty for satisfactory light performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two-year

warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective 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 his own cost and with no extra remuneration to be paid for such works.

8. Measurement for Payment

The measurement of Cats eye (MMC) shall be in numbers of markers supplied and fixed.

9. Rate

The contract unit rate for Cats eye (MMC) shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawings or as directed. The contract unit rate shall be for a unit of one No.

**Item no. 14:**

**Type - A, "W" : Metal Beam Crash Barrier (Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause Type - A, "W" : Metal Beam Crash Barrier (Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause 811)**

The measurement of "W" metal beam crash barrier shall be in meter of crash barrier fixed.

**General**

This work shall consist of furnishing and erection of metal beam crash barrier of dimensions and at locations as shown on the drawing (s) or as directed by the Engineer,

Metal beam crash barrier shall generally be located on approaches to bridge structures, at locations where the embankment height is more than 3 metres and at horizontal curves,

**Materials**

Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the plans. Railing posts shall be made of steel of the section, weight and length as shown on the plans. All complete steel rail elements, terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised. All elements of the railing shall be free from abrasions, rough or sharp edges and shall not be kinked, twisted or bent.

Steel beam elements and terminal sections shall be galvanised (zinc coated, 0.55 kg per square metre, minimum single spot) unless otherwise specified. The galvanising on all other steel parts shall conform to the relevant IS Specifications, All fittings (bolts, nuts, washers) shall conform to the IS :

1367 and IS : 1364. All galvanizing shall be done after fabrication.

Concrete for bedding and anchor assembly shall conform to Section 1700 of these Specifications.

#### Construction Operations

The line and grade of railing shall be true to that shown on the plans. The railing shall be carefully adjusted prior to fixing in place, to ensure proper matching at abutting joints and correct alignment and

camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawing, railing steel posts shall be given one shop coat of paint (primer) and three coats of paint on structural steel after erection, if the sections are not galvanised. Any part of assembly below ground shall be painted with three coats of red lead paint.

Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

#### Installation of Posts

Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipment, provided these are erected in proper position and are free from distortion and burring or any other damage.

All post holes that are dug or drilled shall be of such size as will permit proper setting of the posts and allow sufficient room

or backfilling and lapping.

Holes shall be backfilled with selected earth or stable materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed. When backfilling and tamping are completed, the posts or anchors shall be held securely in place.

Post holes that are drilled in rock and holes for anchor posts shall be back filled with concrete.

Posts for metal beam guardrails on bridges shall be set to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

#### Erection

All guardrail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the Engineer.

All bolts or clips used for fastening the guardrail or fittings to the posts shall be drawn up tightly. Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut, except in which such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

#### Tolerance

The posts shall be vertical with a tolerance not exceeding 6 mm in a length of 3 metre. The railing barrier shall be erected true to line and grade.



#### Measurements for Payment

Metal beam railing barriers will be measured by linear metre of completed length as per plans and accepted in place. Terminals/ anchors of various types shall be paid for by numbers.

No measurement for payment shall be made for projections or anchors beyond the end posts except as noted above. Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges

shall be Considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

**Item No-15. Direction sign (Junction board):-Providing and fixing sing boards made out of 2mm aluminium sheet; size 244 x 122cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)... For DD plan**

#### **Scope:-**

Direction sign (Junction board):-Providing and fixing sing boards made out of 2mm aluminium sheet; size 244 x 122cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)... For DD plan.

This item shall be executed as per Morth and IS code specification and instructed by Engineer in charge.

The contractor have to use require all material as per scope of work & specification.

The measurement shall be taken on the Number basis of road Signage Board fixed at site of work.

**The contract rate shall be for a unit of one No. of Sign Board fixed at site of work.**

#### **Item no-16**

**Distance Informatory/ Destubatuib sign :Providing and fixing sing boards made out of 2mm aluminium sheet; size 180 x 120cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75 x 75 x 6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...**

**Scope :-** Distance Informatory/ Destubatuib sign :Providing and fixing sing boards made out of 2mm aluminium sheet; size 180 x 120cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 75 x 75 x 6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

This item shall be executed as per Morth and IS code specification and instructed by Engineer in charge.

The contractor have to use require all material as per scope of work & specification.

The measurement shall be taken on the Number basis of road Signage Board fixed at site of work.

**The contract rate shall be for a unit of one No. of Sign Board fixed at site of work.**

#### **Item no-17**

**Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30 cm length, 30 cm height and 15 cm thick of M200 grade concret as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1 cement: 3 fine sand) etc complete.**

Providing and fixing approved quality and make rubber molded precast cement concrete blocks of M-200 having 30 cm length and 30 cm height, 15 cm thick with top shape of edge chamfered as per attached drawing and manufactured in automatic press machine. The minimum compressive strength of the kerb blocks should be 200kg/ cm<sup>2</sup>. The blocks to be laid as per drawing and details given by the Engineer in charge. Kerb blocks to be laid in required line and level with flush joints filled up in C. M. (1:1) Including painting on kerbing, lines, dashes, arrows, letter on block in two coats with road marking paint as approved by engineer incharge brushing including cleaning the surface of all dirt, dust and other foreign matter etc complete Rate includes cost of all materials, labour, transportation, equipments and all taxes etc.

#### **MATERIAL**

- The size of precast cement concrete block of M-200 having 30 cm length and 30 cm height, 15 cm thick with top shape of edge chamfered as per attached drawing and as per shape approved by the Engineer in Charge, manufactured in rubber molded automatic press machine.
- Shape - Uniform unit shape

- Tolerance in size  $\pm 1$  mm in length and width all sides
- Colour: Natural Cement Colour. The top and outer surface should be a smooth shining surface.
- Compressive strength - Minimum 200 kg/cm<sup>2</sup> as specified
- Testing norms - 5 blocks out of 10000 Nos. of paving blocks

#### WORKMANSHIP

Laying of inter Kerb blocks to be started after completion of road work.

Kerb blocks to be laid with the joints between the block should not exceed 15mm. The spacing shall be consistent so that uniform pattern can be maintained. After laying Kerbing proper curing shall be done.

Laying shall be done in true line & level/ slope in 30 Mtrs spans by use of string.

Mode of measurements & payment

The longitudinal length of block shall be measured under this item.

Mode of measurement: The payment shall be made unit running meter.

#### Item no. 18:

**Painting lines, deashes, arrows, letters etc on roads, Air field sand like in two coats with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter(i) Over 10 cm in width.**

This item shall be executed as per Morth specification & IS code and instructed by Engineer in charge.

All required materials should be used as per Morth specification & IS code and instructed by Engineer in charge.

The measurement of this item shall be in Sq.meter of work done.

**Item No. 19 Filling in foundation and plinth with murrum or selected soil in layers of 20cm. thickness including watering, ramming and consolidating etc. complete.**

#### Material Requirements

- **Soil/Murrum Quality:** The murrum or selected soil must be of approved quality, free from large lumps, salts, organic matter, and other deleterious substances. All clods must be broken before spreading.
- **Moisture:** Earth should be brought to an optimum moisture content (OMC) so that the specified dry density can be achieved during compaction.

#### Workmanship & Execution

1. **Preparation:** Before any filling begins, the foundation or plinth area must be cleared of all debris, timber, mortar droppings, and loose material.
2. **Layer Thickness:** The filling is deposited in uniform, loose horizontal layers, each not exceeding 20 cm in thickness.
3. **Watering & Compacting:** Each layer is adequately watered to ensure proper moisture and uniformly consolidated by ramming.
4. **Ramming Tools:** Manual ramming is done using iron or wooden rammers. In confined spaces like trenches and foundation sides where rammers cannot reach, the ends of crowbars are used to pack the soil.

5. **Successive Layers:** No subsequent layer is placed until the underlying layer is properly consolidated and approved by the site engineer.
6. **Final Consolidation:** Once the filling reaches the required finished level, the surface is flooded with water for at least 24 hours (depending on specific project parameters), allowed to dry, and then final-rammed to the exact shape required to receive the flooring.

**Mode of Measurement & Payment**

- **Unit of Measurement:** The volume of the consolidated filling is calculated in cubic meters (Cu.Mt) or cubic meters (Cmt) based on the length, breadth, and depth of the filled area

**Item No-20 & 24**

**Excavation for foundation upto 1.5 m depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead. (C) Hard murrum.**

**Item no. 50 Excavation for foundation upto 1.5 m depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead. B) IN HARD ROCK**

**SCOPE:**

This item shall consist of excavation, removal and satisfactory disposal of all materials necessary widening of Road, Re-sectioning & Profile correction of Road., Side Shoulder & Road by using cutting stuff received from cutting, in accordance with the requirement of these specification including all lead and lift and conformity with the lines, grades and cross sections shown in the drawings or directed by the engineer- in – charge. This work shall include the hauling and stacking of or hauling to sites of embankment for land scapping Island, Road work & side shoulder construction etc. of suitable cut materials as required and also the disposal of unsuitable cut materials in specified manner, including all lead and lifts including trimming and finishing of the road to specified dimensions or as directed by the engineer in charge including rolling and watering etc. complete.

**CLASSIFICATION OF EXCAVATED MATERIALS:**

Before excavation bidder shall carry out the preliminary survey / contouring preparing L-S for road, formation level & work out the cutting / filling quantity within the estate shall be got approved from the engineer in charge. The excavated stuff utilized in embankment in road area as well as speeded& filled up in low laying area within the estate as directed by engineer in charge.

**Classification:**

All materials involved in excavation shall be classified by the engineer in charge in the following groups:

- 1) All sorts of soil and soft murrum
- 2) Hard murrum
- 3) Soft rock not required blasting
- 4) Hard rock ( not required blasting)
- 5) Hard rock (required blasting)

6) Hard rock (blasting prohibited)

**Authority for Classification:**

The classification of excavation shall be decided by the Engineer in charge and his decision shall be final and binding to the contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer in charge.

**2. CONSTRUCTION OPERATIONS:**

**3.1) SITE CLEARANCE:**

The land width on which the earth work is to be done, shall be cleared from all trees, bushes, shrubs, rubbish and other objectionable materials. Useful material shall be arranged in convenient stacks and un-useful material shall be burnt or otherwise disposed off by contractor at his own cost. MoRTH specification clause No.201 shall be also followed.

**SETTING OUT:**

After the site has been cleared, the limits of excavation and the alignment of the road shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer in charge. The contractor provide all labour and materials such as strings, time pegs, stones etc. required in connection with the setting out of works and establishment of Temporary & permanent Bench mark, center line stone & other marks. The contractor shall be responsible for the maintenance of the bench mark and other marks, and stacks as long as in the opinion of the Engineer in charge. Before start of the work, toe line of embankment shall be marked on ground.

**COMPACTING ORIGINAL GROUND:**

The original ground, where construction of embankment for land scrapping Island, Road work, side shoulders and water way to be done, with excavated stuff shall be consolidated by rolling as directed by Engineer in charge and in accordance with MoRTH specification Clause No.305.3.4.

**EXCAVATION:**

All excavation shall be carried out in a manner approved by the Engineer in charge and in conformity with the directions laid herein under and in manner approved by the Engineer in charge. The work shall be so done that the suitable materials available from excavation are satisfactory utilized as decided upon beforehand.

While planning or executing excavations, the contractor shall take all adequate precaution against soil erosion, water pollution etc. as per MoRTH Clause No.306 & take appropriate drainage measures to keep the site free from water in accordance with the MoRTH Clause No.311.

The excavation shall conform to the lines, side slopes, and levels shown on the drawings or directed by the Engineer in charge. The contractor shall not excavate outside the limit of excavation subject to the permitted tolerance, any excess depth/width excavated beyond the specified levels/ dimensions on the drawing shall be made at the cost of contractor with suitable material of characteristics similar to that removed and compacted to the requirements of MoRTH clause No.305.

Care shall be taken to see that excavation is arranged in a safety way so that there will be no risk to the work or workmen. If slides occur in cutting during the process of the construction, they shall be removed at the cost of contractor as ordered by the Engineer in charge. While planning or executing excavations, the contractor shall take all adequate precautions against soil erosion, water pollution etc. as per MoRTH specification clause no.306.

All debris and loose materials on the slopes of cutting shall be removed. No back filling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in instruction of the Engineer in charge & the resulting cavities filled with suitable materials and thoroughly compacted in an approved manner.

For rock excavation, specifications under MoRTH clause No. 301.3.5 shall be followed.

#### **DISPOSAL & UTILIZING OF EXCAVATED STUFF:**

All the excavated material shall be property of the corporation. The material obtained from the excavation of roadways, widening work, SWD, foundation for structures etc. shall be used for the work of embankment, for land scrapping Island, Road work, embankment for side shoulder of roads & embankment work as directed by the Engineer in charge including leveling & spreading with all lead and lift and no extra payment shall be made for the same.

Unsuitable and surplus materials not intended for use shall be removed from site of the work to outside estate limit or within estate limit by suitable means. No extra payment shall be made for the same..

The useful excavated materials shall be used in embankment and it shall be directly deposited at the required location in specified layer. No handling or conveyance charges shall be paid. If no DGIDCIEA land is available, but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements for the stacking of this material temporarily on private land or land of plot holders, by paying rent etc. without claiming any compensation. Surplus material not required for use on embankment or unsuitable materials may be used of his own cost to uniformity widen embankment to flatten slopes and fill low places in the road land or plot land, if so permitted by the Engineer in charge. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer in charge.

The excavation shall be finished neatly, smoothly and evenly to the correct lines, curves, grades sections and side slopes as shown on the plans or directed by the Engineer. 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.

#### **SPREADING THE EXCAVATED STUFF IN LAYERS:**

The excavated stuff shall be spread uniformly over the entire width of embankment for land scrapping Island, Road work, side shoulders in layers not exceeding 250 mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down in the detailed specifications of MoRTH

Clods or hard lumps of cutting stuff shall be broken as directed by the Engineer in charge.

#### **DEWATERING:**

If water is met with the excavation due to springs, seepage, rain etc. shall be removed by suitable diversions, pumping or bailing out and the excavation part kept dry whenever so required or directed. Care shall be taken to discharge, the drained water into suitable outlets as not to cause damage to the works, demarcated plots, crops any other property. Due to any negligence on the part of the contractor, if any such damage is caused, it shall be the sole responsibility of the contractor to repair/ restore to the original condition at his own cost or compensate for the damage. MoRTH Specification Clause No. 304.3.3 shall also apply.

#### **PUBLIC SAFETY:**

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

**PRESERVATION OF PROPERTY:**

The contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing road side trees, structures, drains, sewers, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer in charge shall be continued in use without any change. Safeguards taken by the contractor in this respect, shall be got approved by him from the Engineer in charge. However, if any of these objects is damaged by reason of the contractor's negligence, it shall be replaced or restored to the original condition at his expense. If the contractor fails to do so, within the required times as directed by the Engineer in charge or if, in the opinion of the Engineer, the actions initiated by the contractor to replace/ restore the damage objects are not satisfactory, the Engineer shall arrange the replacement/ restoration directly through any other agency at the risk and cost of the contractor after issuing a prior notice to the effect.

**REPARATION OF CUT FORMATION**

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub – base / base course as directed by Engineer.

Any unsuitable material encountered in the sub grade level shall be removed as directed by Engineer in charge & replace with suitable materials compacted in accordance with the MoRTH clause no.305.

In rock formations, the surface irregularities shall be corrected and the level brought up to the specified elevation with granular base material as directed by the Engineer in charge, laid and compacted in accordance with the respective specifications of these materials. After satisfying the density requirement, the cut formation shall be prepared and to receive the sub-base / base course in accordance with MoRTH Clause No.310 & 311 to receive the sub-base/ base course.

**FINISHING OPERATIONS:**

Finishing operations shall include the work of properly shaping and dressing all excavated surface/embankment works, and shall conform to MoRTH specification Clause No.301.7 and 305.3.9.

The finished cut surface shall satisfy the surface tolerance described in MoRTH Clause 902.

**3. QUALITY CONTROL OF WORK:**

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with these specifications and general specification for quality control on works and materials attached herewith. All testing charges shall be borne by the contractor.

**4. ARRANGEMENT FOR TRAFFIC:**

MoRTH specification Clause –112 shall be applicable.

**5. MODE OF MEASUREMENT & PAYMENT:**

The contract rate shall be for a unit of one cubic meter for the strata mentioned in the wording of the item of excavation acceptable completed and limited to the dimensions shown on the plans and construction of embankment/ side shoulders with cutting stuff, acceptably completed and limited to the dimensions only. Excavation shall be measured in its original position by taking cross sections before the work starts and after it is entirely completed, or levels shall be taken before and after construction. The quantity shall be worked out by the average end area method. Where it is not feasible to compute volumes by this method, because of erratic location of isolated deposits, the volumes shall be computed of the strata changes, the contractor shall bring this to the

notice of the Engineer-in-charge who will then verify and if necessary take levels for the changed strata for purposes of measurements.

Levels and sections of the ground shall be taken in the presence of the contractor or his authorized agent before the excavation is started so as to serve as the basis of measurement. The contractor or his representative shall sign the field book in token of his acceptance of the levels. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific 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 field book shall not be deemed as disagreement.

The contract unit rate for this item shall be payment in full for carrying out the required operations including full compensation for setting out, transporting the excavated materials & disposing the same on site of the embankment/ work of side shoulder etc. as directed within all lead and lift. trimming bottoms and slopes of excavation, dewatering, keeping the work free of water as per clause 311, all materials, labours, tools, equipment, safety measures all testing charges, making arrangement for traffic and incidentals necessary to complete the work to the specifications above and all leads and lifts. No extra payment shall be made for the cutting stuff used in embankment/ shoulders.

**The contract unit rate shall be for a unit of one Cubic meter of finished work at the site of work.**

#### **Item no-21**

**Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M.1:2 watering and laying (To level of slops of I.S.458/1971Class NP4 of following internal diameter. (i) 300 mm dia.**

**Scope :-** Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M.1:2 watering and laying (To level of slops of I.S.458/1971Class NP4 of following internal diameter. (i) 300 mm dia.

The contractor have to use all require material as per Morth specification & IS code and as per instruction of Engineer – in- charge.

The contractor have to execute work as per specification and line level.

This item shall be executed as instructed by Engineer incharge.

Heavy Duty NP4 pipe for Pipe Culvert

Mode of measurement: The payment shall be made on mtr of work done.

**Item no. 22. Filling available excavated earth in trenches, plinth, sides of foundations etc. layers not exceeding 20 cm. in depth consolidating each deposited layer by ramming and watering.**

#### **1. Material Requirements**



- **Quality of Earth:** The soil used must be free from clods, debris, roots, vegetation, salts, sulfates, and other harmful organic materials.
- **Broken Lumps:** All large earth clods must be broken down and pulverized. If the excavated material contains rock or boulders, they must be broken into pieces no larger than 150 mm and mixed with fine material to fill voids.
- **Rejection:** Soil with high amounts of deleterious salts or highly expansive clays is typically rejected for foundation filling.

## 2. Execution & Methodology

- **Layer Thickness:** Backfilling must be executed systematically in loose layers. The thickness of each uncompacted layer must **not exceed 20 cm**.
- **Watering:** Each layer must be thoroughly watered to achieve optimum moisture content (OMC) prior to compaction.
- **Ramming/Compaction:** The wetted earth must be densely consolidated using iron rammers, steel rammers, or mechanical rammers (plate compactors). For larger scale plinth filling, an 8 to 10-tonne power roller or vibratory compactor may be directed by the Engineer.

## 3. Surface Preparation & Safety

- **Clearance:** Before any earth is placed, foundation trenches must be cleared of all debris, timber, and loose materials.
- **Lifts and Leads:** The specification includes standard leads (typically up to 50 meters of transport from the stack) and lifts appropriate to the foundation depth.
- **Safety:** Deep trenches (typically > 1.5 meters) must be shored properly prior to any workmen entering to ram or water the earth.

## 4. Measurements & Payments

- **Unit of Measurement:** The volume of compacted earth filled is measured in cubic meters (m<sup>3</sup>).

### Item no.24

#### Rolling and consolidation using vibratory road roller 8 -10 tonne capacity (incl. watering)(A) Earth work (layer not exceeding 200mm thickness)

Rolling to be carried out on top surface of existing soil with power roller as per instructions of Engineer incharge. The top surface of soil after rolling & consolidation shall be as per required camber and gradient as approved by engineer in-charge.

### 10. Scope of Work

This specification covers the methodology for rolling and consolidating the soil layer, ensuring a uniformly compacted surface with proper camber and gradient, as per the instructions of the Engineer-in-Charge and relevant Indian Standards.

### 11. Applicable Standards

5. **IS 2720 (Part 8):** Determination of water content and dry density relationship of soil.
6. **IS 10379:** Rolling and compaction equipment standards.
7. **IRC: 36-2010:** Recommended practice for the construction of granular sub-base.
8. **IS 3764:** Safety code for excavation work.

### 12. Equipment and Materials

#### 3. Power Roller:

- o Type: Smooth-wheeled, self-propelled.
- o Weight: 8–10 tonnes, as per design requirements.

#### 4. Filling Material:

- o Excavated soil free from debris, organic matter, and oversized particles (maximum size: 40 mm for granular sub-base).
- o Moisture content adjusted to optimum moisture content (OMC) before placement.

### 13. Pre-Rolling Preparation

#### 3. Surface Cleaning:

- o Remove debris, loose material, and vegetation from the soil surface.
- o Ensure no standing water is present; if necessary, allow time for drying.

#### 4. Inspection:

- o The Engineer-in-Charge must inspect the base layer for level and preliminary slope conformity.

### 14. Rolling and Consolidation Procedure

#### 14.1. Initial Rolling

4. Begin rolling along the longitudinal axis of the surface. Start at one edge and work towards the center to achieve proper compaction.
5. Use overlapping passes, ensuring at least one-third overlap on each pass to cover the entire surface uniformly.
6. Rolling should be performed at a consistent speed to avoid uneven compaction.

#### 14.2. Handling Depressions

4. Any depressions occurring during rolling must be promptly filled with pre-approved soil.
5. Fill material should be placed in layers no thicker than 150 mm, spread evenly, and compacted using hand tampers or smaller mechanical rollers to the satisfaction of the Engineer.
6. The area should then be re-rolled using the power roller until uniform compaction is achieved.

#### 14.3. Final Rolling

4. Conduct final rolling to achieve a smooth surface with the required camber and gradient.
5. Apply water to control dust and maintain the surface's moisture content.
6. Confirm the compacted surface is stable and does not deform under the roller's weight.

### 15. Inspection by Engineer:

- After rolling, the Engineer shall verify compaction density, uniformity, and adherence to specified slope and levels before proceeding further.

All the works shall be carried out as per instruction of engineer in-charge.

In case of any discrepancies, the decision of engineer in charge shall be final and binding on the agency.

In case of any missing detail or any discrepancies, the same shall be brought to the notice of engineer in-charge immediately.

The work shall be carried out till the satisfaction of engineer in-charge

### 16. Safety Provisions

4. Maintain a safe distance between personnel and operating machinery.

5. Use warning signs or barricades around the rolling area.
6. Ensure operators are trained and use personal protective equipment (PPE) such as helmets, gloves, and safety boots.

17. **Post-Work Requirements**

- Remove loose material displaced during the compaction process.
- Re-inspect and record levels to confirm compliance with design specifications.
- Hand over the surface for the next stage of construction only upon formal approval by the Engineer-in-Charge.

18. **Notes and Special Instructions**

4. Avoid rolling during adverse weather conditions, such as heavy rainfall, to ensure consistency in compaction.
5. Ensure continuous availability of filling material to minimize delays during the rolling process.
6. Regularly calibrate the power roller's weight and check functionality to meet rolling standards.

**MODE OF MEASUREMENT & PAYMENT:**

The contract unit rate shall be for a unit of one Cum of finished work at the site of work.

**Item No-25**

**Excavation for foundation for depth from 1.5 m to 3.0 m including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead. (D) Soft rock not requiring Blasting**

**SCOPE:**

This item shall consist of excavation, removal and satisfactory disposal of all materials necessary widening of Road, Re-sectioning & Profile correction of Road., Side Shoulder & Road by using cutting stuff received from cutting, in accordance with the requirement of these specification including all lead and lift and conformity with the lines, grades and cross sections shown in the drawings or directed by the engineer- in – charge. This work shall include the hauling and stacking of or hauling to sites of embankment for land scapping Island, Road work & side shoulder construction etc. of suitable cut materials as required and also the disposal of unsuitable cut materials in specified manner, including all lead and lifts including trimming and finishing of the road to specified dimensions or as directed by the engineer in charge including rolling and watering etc. complete.

**CLASSIFICATION OF EXCAVATED MATERIALS:**

Before excavation bidder shall carry out the preliminary survey / contouring preparing L-S for road, formation level & work out the cutting / filling quantity within the estate shall be got approved from the engineer in charge. The excavated stuff utilized in embankment in road area as well as speeded& filled up in low laying area within the estate as directed by engineer in charge.

**Classification:**

All materials involved in excavation shall be classified by the engineer in charge in the following groups:

- 7) All sorts of soil and soft murrum

- 8) Hard murrum
- 9) Soft rock not required blasting
- 10) Hard rock ( not required blasting)
- 11) Hard rock (required blasting)
- 12) Hard rock (blasting prohibited)

#### **Authority for Classification:**

The classification of excavation shall be decided by the Engineer in charge and his decision shall be final and binding to the contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer in charge.

### **6. CONSTRUCTION OPERATIONS:**

#### **3.1) SITE CLEARANCE:**

The land width on which the earth work is to be done, shall be cleared from all trees, bushes, shrubs, rubbish and other objectionable materials. Useful material shall be arranged in convenient stacks and un-useful material shall be burnt or otherwise disposed off by contractor at his own cost. MoRTH specification clause No.201 shall be also followed.

#### **SETTING OUT:**

After the site has been cleared, the limits of excavation and the alignment of the road shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer in charge. The contractor provide all labour and materials such as strings, time pegs, stones etc. required in connection with the setting out of works and establishment of Temporary & permanent Bench mark, center line stone & other marks. The contractor shall be responsible for the maintenance of the bench mark and other marks, and stacks as long as in the opinion of the Engineer in charge. Before start of the work, toe line of embankment shall be marked on ground.

#### **COMPACTING ORIGINAL GROUND:**

The original ground, where construction of embankment for land scrapping Island, Road work, side shoulders and water way to be done, with excavated stuff shall be consolidated by rolling as directed by Engineer in charge and in accordance with MoRTH specification Clause No.305.3.4.

#### **EXCAVATION:**

All excavation shall be carried out in a manner approved by the Engineer in charge and in conformity with the directions laid herein under and in manner approved by the Engineer in charge. The work shall be so done that the suitable materials available from excavation are satisfactory utilized as decided upon beforehand.

While planning or executing excavations, the contractor shall take all adequate precaution against soil erosion, water pollution etc. as per MoRTH Clause No.306 & take appropriate drainage measures to keep the site free from water in accordance with the MoRTH Clause No.311.

The excavation shall conform to the lines, side slopes, and levels shown on the drawings or directed by the Engineer in charge. The contractor shall not excavate outside the limit of excavation subject to the permitted tolerance, any excess depth/width excavated beyond the specified levels/ dimensions on the drawing shall be

made at the cost of contractor with suitable material of characteristics similar to that removed and compacted to the requirements of MoRTH clause No.305.

Care shall be taken to see that excavation is arranged in a safety way so that there will be no risk to the work or workmen. If slides occur in cutting during the process of the construction, they shall be removed at the cost of contractor as ordered by the Engineer in charge. While planning or executing excavations, the contractor shall take all adequate precautions against soil erosion, water pollution etc. as per MoRTH specification clause no.306.

All debris and loose materials on the slopes of cutting shall be removed. No back filling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in instruction of the Engineer in charge & the resulting cavities filled with suitable materials and thoroughly compacted in an approved manner.

For rock excavation, specifications under MoRTH clause No. 301.3.5 shall be followed.

#### **DISPOSAL & UTILIZING OF EXCAVATED STUFF:**

All the excavated material shall be property of the corporation. The material obtained from the excavation of roadways, widening work, SWD, foundation for structures etc. shall be used for the work of embankment, for land scrapping Island, Road work, embankment for side shoulder of roads & embankment work as directed by the Engineer in charge including leveling & spreading with all lead and lift and no extra payment shall be made for the same.

Unsuitable and surplus materials not intended for use shall be removed from site of the work to outside estate limit or within estate limit by suitable means. No extra payment shall be made for the same..

The useful excavated materials shall be used in embankment and it shall be directly deposited at the required location in specified layer. No handling or conveyance charges shall be paid. If no DGIDCIEA land is available, but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements for the stacking of this material temporarily on private land or land of plot holders, by paying rent etc. without claiming any compensation. Surplus material not required for use on embankment or unsuitable materials may be used of his own cost to uniformity widen embankment to flatten slopes and fill low places in the road land or plot land, if so permitted by the Engineer in charge. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer in charge.

The excavation shall be finished neatly, smoothly and evenly to the correct lines, curves, grades sections and side slopes as shown on the plans or directed by the Engineer. 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.

#### **SPREADING THE EXCAVATED STUFF IN LAYERS:**

The excavated stuff shall be spread uniformly over the entire width of embankment for land scrapping Island, Road work, side shoulders in layers not exceeding 250 mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down in the detailed specifications of MoRTH

Clods or hard lumps of cutting stuff shall be broken as directed by the Engineer in charge.

#### **DEWATERING:**

If water is met with the excavation due to springs, seepage, rain etc. shall be removed by suitable diversions, pumping or bailing out and the excavation part kept dry whenever so required or directed. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, demarcated plots, crops any other property. Due to any negligence on the part of the contractor, if any such damage is caused, it shall be the

sole responsibility of the contractor to repair/ restore to the original condition at his own cost or compensate for the damage. MoRTH Specification Clause No. 304.3.3 shall also apply.

#### **PUBLIC SAFETY:**

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

#### **PRESERVATION OF PROPERTY:**

The contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing road side trees, structures, drains, sewers, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer in charge shall be continued in use without any change. Safeguards taken by the contractor in this respect, shall be got approved by him from the Engineer in charge. However, if any of these objects is damaged by reason of the contractor's negligence, it shall be replaced or restored to the original condition at his expense. If the contractor fails to do so, within the required times as directed by the Engineer in charge or if, in the opinion of the Engineer, the actions initiated by the contractor to replace/ restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/ restoration directly through any other agency at the risk and cost of the contractor after issuing a prior notice to the effect.

#### **REPARATION OF CUT FORMATION**

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub – base / base course as directed by Engineer.

Any unsuitable material encountered in the sub grade level shall be removed as directed by Engineer in charge & replaced with suitable materials compacted in accordance with the MoRTH clause no.305.

In rock formations, the surface irregularities shall be corrected and the level brought up to the specified elevation with granular base material as directed by the Engineer in charge, laid and compacted in accordance with the respective specifications of these materials. After satisfying the density requirement, the cut formation shall be prepared and to receive the sub-base / base course in accordance with MoRTH Clause No.310 & 311 to receive the sub-base/ base course.

#### **FINISHING OPERATIONS:**

Finishing operations shall include the work of properly shaping and dressing all excavated surface/embankment works, and shall conform to MoRTH specification Clause No.301.7 and 305.3.9.

The finished cut surface shall satisfy the surface tolerance described in MoRTH Clause 902.

#### **7. QUALITY CONTROL OF WORK:**

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with these specifications and general specification for quality control on works and materials attached herewith. All testing charges shall be borne by the contractor.

#### **8. ARRANGEMENT FOR TRAFFIC:**

MoRTH specification Clause –112 shall be applicable.

#### **9. MODE OF MEASUREMENT & PAYMENT:**

The contract rate shall be for a unit of one cubic meter for the strata mentioned in the wording of the item of excavation acceptable completed and limited to the dimensions shown on the plans and construction of embankment/ side shoulders with cutting stuff, acceptably completed and limited to the dimensions only. Excavation shall be measured in its original position by taking cross sections before the work starts and after it is entirely completed, or levels shall be taken before and after construction. The quantity shall be worked out by the average end area method. Where it is not feasible to compute volumes by this method, because of erratic location of isolated deposits, the volumes shall be computed of the strata changes, the contractor shall bring this to the notice of the Engineer-in-charge who will then verify and if necessary take levels for the changed strata for purposes of measurements.

Levels and sections of the ground shall be taken in the presence of the contractor or his authorized agent before the excavation is started so as to serve as the basis of measurement. The contractor or his representative shall sign the field book in token of his acceptance of the levels. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific 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 field book shall not be deemed as disagreement.

The contract unit rate for this item shall be payment in full for carrying out the required operations including full compensation for setting out, transporting the excavated materials & disposing the same on site of the embankment/ work of side shoulder etc. as directed within all lead and lift. trimming bottoms and slopes of excavation, dewatering, keeping the work free of water as per clause 311, all materials, labours, tools, equipment, safety measures all testing charges, making arrangement for traffic and incidentals necessary to complete the work to the specifications above and all leads and lifts. No extra payment shall be made for the cutting stuff used in embankment/ shoulders.

**The contract unit rate shall be for a unit of one Cubic meter of finished work at the site of work.**

**Item no. 26 Uncoursed Rubble Masonry with hard stone of approved quality in foundations and plinth in Cement Mortar 1:6 (1-cement : 6-coarse sand including levelling up etc. complete**

**1. Materials**

- **Stone:** The hard stone must be of approved quality, dense, durable, and sound, free from cracks, decay, and weathering. The compressive strength should ideally be  $> 300 \text{ kg/cm}^2$  and water absorption  $< 5\%$ . Stones must be roughly hammered-dressed to remove sharp edges.
- **Cement:** Fresh, standard 53-grade or 43-grade Ordinary Portland Cement conforming to Indian Standards.
- **Coarse Sand:** Clean, sharp, and free of silt, organic matter, or deleterious salts.
- **Water:** Clean, potable water, free from injurious amounts of oils, acids, alkalis, or vegetable matter.

**2. Cement Mortar (1:6)**

- **Proportion:** 1 part cement: 6 parts coarse sand by volume.
- **Mixing:** Mixed thoroughly in a mechanical mixer to obtain a uniform color and desired consistency. For hand mixing, it must be done on a watertight platform. Mortar should be freshly mixed and consumed within 30 minutes of adding water.

**3. Laying & Construction**

- **Wetting:** Stones must be thoroughly wetted with water before laying to prevent the stone from absorbing water from the mortar.
- **Base:** The foundation bed must be cleared, watered, and levelled (using cement concrete/mortar) before starting the first course of masonry.

- **Bond Stones (Through Stones):** A critical requirement of UCR masonry is the insertion of bond stones. They must extend through the full thickness of the wall. For walls up to 60 cm thick, a bond stone must be placed every 1.5 m<sup>2</sup> of the wall area.
- **Bedding & Joints:** Stones must be laid on their natural bed. Gaps and interstices must be filled with cement mortar and tightly packed with stone chips (spalls). The faces of joints should not be left hollow.
- **Thickness of Joints:** Average mortar joints should not exceed 10 mm to 15mm in thickness.
- **Plumb and Level:** The masonry must be kept strictly in plumb using proper wooden templates and lines.
- **Levelling Up:** Every course should be properly leveled up. The top course of plinth must be finished level, generally topped with 12 mm to 20 mm thick cement mortar/concrete to act as a damp-proof course (DPC) base.

#### **4. Curing**

- Masonry work must be kept continuously moist for a minimum of **7 to 10 days** by sprinkling water at regular intervals to allow proper cement hydration and achieve designed strength.

#### **5. Measurements & Payment**

- **Unit:** The item is measured and paid in **Cubic Meters (cum)**.

#### **Item no.27**

**Providing and laying controlled cement concrete M:150 for curing complete excluding cost of formwork and reinforcement for Cement concrete work in [A] Foundations, footings, Base of Columns and Mass Concrete [More than 10 Ton].Materials:**

1.0. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Coarse aggregate shall conform M-12 B.

1.1. The shuttering to be provided shall be of ordinary timber planks and shall conform to M-26.

1.2. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

#### **2.0. General:**

2.1. 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, 1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively.

2.2. The ingredients required for ordinary concrete 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 d aggregate by volume p 50 coarse aggregate Kgs. Of cement to taken as the sum individual volume of fi and coarse aggregate maximum	Proportion of fine aggregate to coarse aggrega by volume but subject to a upper limit of 1:1 ½ and low limit 1:3	Quantity water per Kgs. cement maximum.
M-100 (1:3:6)	300 Liters	Generally 1:2 for fi aggregate	34 Liters
M-150 (1:2:4)	220 "	to coarse aggrega by volume	32 "
M-200 (1:1 ½:3)	160 "	but subject to a upper limit of	30 "
M-250 (1:1:2)	100 "	1:1 ½ and low limit 1:3	27 "

2.3. The water cement ratios shall not more than those specified in the above 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.

2.4. Workability of the concrete shall be controlled by maintaining a water-cement-ratio that is bound to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty with the means available.

2.5. 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 corners of the form.

2.6. For reinforced concrete work, coarse aggregate having a nominal size of 20 mm. are generally considered satisfactory.

2.7. For heavily reinforced concrete members as in the case of 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.

2.8. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be important and the nominal maximum size may sometimes be as great as or greater than the minimum cover.

2.9. 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.

2.10. The form work shall conform to the shape lines and dimension as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding bracing etc. shall be as per design.

2.11. Cleaning & Treatment of forms:

2.11.1. All rubbish, particularly chippings shaving and saw dust shall be removed from the interior of the form before the concrete is placed and the form work in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done, Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil or form oil of approved manufacture may be applied in case steel shuttering is used. Soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforcement bars.

2.12. Stripping time:

2.12.1. In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.:

(a) Sides of walls columns and vertical faces of beam 24 to 48 hours.

(b) Beam soffits. (Props left under) 7 days.

(c) Removal of props slabs

(i) Slabs spanning up to 4.5 m. 7 days.

(ii) Spanning over 4.5 mm. 14 days.

(d) Removal of props to beams and Arches

(i) Spanning upto 6 m. 14 days.

(ii) Spanning over 6 m. 21 days.

2.13. Procedure when removing the form work: 2.4.1. All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffit form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened.

2.14. Centering:

2.14.1. The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behavior of centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

2.14.2. The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.

2.14.3. The centering and form work shall be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to the work, injury to life and damage to property.

2.15. Scaffolding:

2.15.1. All scaffolding, hoisting arrangements and ladders etc. required for the facilitating of concreting shall be provided and removed on completion work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders etc. shall be strong enough to

to act and shall be subject to the approval of the Engineer-in-charge. However, contractor shall

be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.

2.15.2. The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.

2.15.3. The rate is applicable to all conditions of working and height upto 4 mts. The rate shall include the cost of materials and labour for various operations involved such as:

(a) Splayed edges, notching, allowance for overlaps and passing at angles, battens centering, shuttering, strutting, propping bolting, nailing, wedging, easing, striking and removal.

(b) Filleting to form stop chamfered edges or splayed external angles not exceeding 20 mm. widths to beams, columns and the like.

(c) Temporary opening in the forms for pouring concrete, if required, removing rubbish etc.

(d) Dressing with oil to prevent adhesion of concrete with shuttering, and

(e) Raking or circular cutting.

2.16. Re-Use:

2.16.1. Before-re-use, all forms shall be inspected by Engineer-in-charge and their suitability ascertained. The forms shall be scarred, cleaned, and joints gone over, repaired where required. Inside surface shall be retreated to prevent adhesion of concrete.

## **2.0 General:**

2.1. The relevant specifications of item No. 5.4.1. of ordinary concrete shall be followed except that the concrete mix shall be designed from preliminary tests, the proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350, & M-400, with prefix controlled added to it. The letter 'M' refers to mix and numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./Cmt.

2.2. The proportion of cement, sand and coarse aggregates shall be determined by weight the weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design.

The strength requirements of different grade of concrete shall be as under:

Grade Of Concrete	Compressive strength of 15 cms. Cubes in Kg./Cmt. At days, conducted in accordance with I.S. 516-1959.	
	Preliminary test Min.	Work test Min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350
M-400	500	400

In all cases, the 28 days compressive strength specified in above table above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for all purposes as concrete belonging to the lower of the two grades between which its strength lies.

### **3.0 Workmanship:**

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with means available except where it can be shown to the satisfaction of the Engineer-in-charge, that the supply of properly graded aggregate of uniform quality can be maintained till the completion of work. Grading of aggregate shall be controlled by obtaining the coarse aggregates, in different sizes and being in them in the right proportions as required. Aggregate of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags, it shall be weighted separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipments shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge, according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, I.S. 2389 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used as per IS code 456.

**4.0. Mode of measurement and payment:** The rate shall be for a unit of one cubic meter.

**Item no.28 Design, Manufacturing & Supplying factory-made RCC (wet cast) Precast Box Culvert (JIS) category for use in Road Crossing, stormwater drainage, cable trenching, or utility ducts, manufactured by FUJI Silvertch / FIT / Alcock , having dimensions of Width x Depth (in mm) (In to In dimension) and with varies length, with a load-carrying capacity of 70R with minimum earth cushion 200mm for heavy vehicle movement. Box culvert shall have interlocking plug-socket arrangement. Rubber gasket required to ensure water-tight character and for jointing of each segment flange-bolt connection with 12 mm diameter, 50 mm length Grade-8.8 high tensile bolts with zinc coating and round washer or equivalent nut-bolt connection will be supplied as part of the Box culvert. Each drain shall have tie-shaped grooves (10–20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C-40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. Policy letter issued by MoRTH for use of factory made Precast products in Government projects shall be followed to speed up the work. All necessary documents, as specified in the said policy and as mentioned above, shall be submitted for approval of the precast factory to the Executive Engineer, Authority. The manufacturer shall have inhouse product testing facility for box culvert testing for design load capacity. Concrete Stockyard Capacity should be sufficient for stacking of the product and round the year availability. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 2.0 x 2.0 -Box Culvert**

**Item no. 29. 1.5 x 1.4 -Box Culvert.**

**Scope :-** Design, Manufacturing & Supplying factory-made RCC (wet cast) Precast Box Culvert (JIS) category for use in Road Crossing, stormwater drainage, cable trenching, or utility ducts, manufactured by FUJI Silvertch / FIT / Alcock , having dimensions of Width x Depth (in mm) (In to In dimension) and with varies length, with a load-carrying capacity of 70R with minimum earth cushion 200mm for heavy vehicle movement. Box culvert shall have interlocking plug-socket arrangement. Rubber gasket required to ensure water-tight character and for jointing of each segment flange-bolt connection with 12 mm diameter, 50 mm length Grade-8.8 high tensile bolts with zinc coating and round washer or equivalent nut-bolt connection will be supplied as part of the Box culvert. Each drain shall have tie-shaped grooves (10–20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C-40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing

to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. Policy letter issued by MoRTH for use of factory made Precast products in Government projects shall be followed to speed up the work. All necessary documents, as specified in the said policy and as mentioned above, shall be submitted for approval of the precast factory to the Executive Engineer, Authority. The manufacturer shall have inhouse product testing facility for box culvert testing for design load capacity. Concrete Stockyard Capacity should be sufficient for stacking of the product and round the year availability. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 2.0 x 2.0 -Box Culvert and 1.5 x 1.4 -Box Culvert.

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 30. Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing. 2.0 x 2.0 -Box Culvert.**

**Item no. 31 1.5 x 1.4 -Box Culvert**

**Scope :-** Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing, transportation . 2.0 x 2.0 -Box Culvert and 1.5 x 1.4 -Box Culvert.

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 32 Supplying factory-made RCC (wet cast) Precast U-shape drains of T-6 category for use in stormwater drainage, cable trenching, or utility ducts, manufactured by FUJI Silvertch / FIT / Alcock, having dimensions of Width x Depth (in mm) and a length of 2000 mm, with a load-carrying capacity of 4.8 Tonne Axle Load and 2.4 Tonne Wheel Load, suitable for pedestrian vehicular movement of longitudinal drain. Each drain shall have tie-shaped grooves (10–20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 450 mm X 450 mm (into in dimension from top)**

**Item no. 33. 600 mm X 600 mm (into in dimension from top)**

**Item no. 34 750 mm X 750 mm (into in dimension from top)**

**Item no. 35 900 mm X 900 mm (into in dimension from top)**

**Scope :-** Supplying factory-made RCC (wet cast) Precast U-shape drains of T-6 category for use in stormwater drainage, cable trenching, or utility ducts, manufactured by FUJI Silvertch / FIT / Alcock, having dimensions of Width x Depth (in mm) and a length of 2000 mm, with a load-carrying capacity of 4.8 Tonne Axle Load and 2.4 Tonne Wheel Load, suitable for pedestrian vehicular movement of longitudinal drain. Each drain shall have tie-shaped grooves (10–20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 450 mm X 450 mm (into in dimension from top), 600 mm X 600 mm (into in dimension from top), 750 mm X 750 mm (into in dimension from top) 900 mm X 900 mm (into in dimension from top)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.



Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 36 Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing. 450 mm X 450 mm (into in dimension from top)**

**Item no. 37 600 mm X 600 mm (into in dimension from top)**

**Item no. 38 750 mm X 750 mm (into in dimension from top)**

**Item no. 39 900 mm X 900 mm (into in dimension from top)**

**Scope :-** Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing, transportation. 450 mm X 450 mm (into in dimension from top), 600 mm X 600 mm (into in dimension from top), 750 mm X 750 mm (into in dimension from top) & 900 mm X 900 mm (into in dimension from top)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 40 Supplying factory-made RCC (wet cast) Precast U-shape drains of T-25 category for use in stormwater drainage, able trenching, or utility ducts, manufactured by FUJI Silvertch / FIT / Alcock, having dimensions of Width x Depth (in mm) and a length of 2000 mm, with a load-carrying capacity of 10 Tonne Axle Load and 5 Tonne Wheel Load, suitable for heavy vehicular movement of longitudinal drain. Each drain shall have tie-shaped grooves (10-20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and**

**installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 1200 mm X 1200 mm (into in dimension from top)**

**Scope:** Supplying factory-made RCC (wet cast) Precast U-shape drains of T-25 category for use in stormwater drainage, cable trenching, or utility ducts, manufactured by FUJI Silvertex / FIT / Alcock, having dimensions of Width x Depth (in mm) and a length of 2000 mm, with a load-carrying capacity of 10 Tonne Axle Load and 5 Tonne Wheel Load, suitable for heavy vehicular movement of longitudinal drain. Each drain shall have tie-shaped grooves (10–20 mm width and 25 mm depth) on both ends for proper joint alignment and secure placement. The drains shall be manufactured using minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and The precast factory should have its own NABL approved QA-QC laboratory within plant premises to ensure daily testing of precast products. MOU / Affidavit stating association with outside laboratory is not permitted. NABL certificate shall be in name of bidder. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 1200 mm X 1200 mm (into in dimension from top)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 41 Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing. 1200 mm X 1200 mm (into in dimension from top)**

**Scope:-** Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing, transportation .1200 mm X 1200 mm (into in dimension from top)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 42 Supplying factory-made RCC (wet cast) Precast Chamber for use in stormwater drainage, manufactured by FUJI Silvertch / FIT / Alcock, with a load-carrying capacity of 10 Tonne Axle Load and 5 Tonne Wheel Load, suitable for heavy vehicular movement. The contractor shall prepare and provide the base with PCC/Foundation concrete as a levelling course based on drawings or consultant recommendations as per foundation strata. The chamber shall include specially designed in-built lifting inserts for safe and fast mechanical installation using Eye Bolt, with required openings to be made at site (not at factory) on the waffle side for utility connections as per actual site needs. Under no circumstances shall site casting be allowed; all units must be produced in a controlled factory environment adhering to an approved QAP. The drains shall be manufactured using high-performance self-compacting concrete minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and equipped with in-house NABL-accredited testing laboratories, steam curing, and RO water facilities. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 800 mm X 800 mm x 800 mm (into in dimension)**

**Item no. 43 800 mm X 800 mm x 1000 mm (into in dimension)**

**Item no. 44 1000 mm X 1000 mm x 1200 mm (into in dimension from top)**

**Item no. 45 1600 mm X 1400 mm x 2000 mm (into in dimension)**

**Scope :-** Supplying factory-made RCC (wet cast) Precast Chamber for use in stormwater drainage, manufactured by FUJI Silvertch / FIT / Alcock, with a load-carrying capacity of 10 Tonne Axle Load and 5 Tonne Wheel Load, suitable for heavy vehicular movement. The contractor shall prepare and provide the base with PCC/Foundation concrete as a levelling course based on drawings or consultant recommendations as per foundation strata. The chamber shall include specially designed in-built lifting inserts for safe and fast mechanical installation using Eye Bolt, with required openings to be made at site (not at factory) on the waffle side for utility connections as per actual site needs. Under no circumstances shall site casting be allowed; all units must be produced in a controlled factory environment adhering to an approved QAP. The drains shall be manufactured using high-performance self-compacting concrete minimum M-50/C40 grade concrete duly steam cured for durability, OPC 53 Grade cement with admixtures as per IS:456-2000, and coarse and fine aggregates derived from natural sources. Reinforcement shall be with TMT/TMX bars of Fe 500D or higher, conforming to IS:1786, fabricated using in-house automated cage-making units for consistency. RO water shall be used during manufacturing to enhance durability. The factory shall be certified with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health & Safety), and equipped with in-house NABL-accredited testing laboratories, steam curing, and RO water facilities. The precast units must comply with Indian and international standards (such as JIS, ASTM, or EU standards) and align

with MoRTH policy guidelines for use in Central and State Government projects. The rate shall include all costs of materials, labour at the plant, reinforcement, formwork, lifting inserts/accessories, and transportation to the site (excluding unloading and installation), along with one-time free technical assistance for installation. All work shall be carried out as per the direction of the Engineer-in-Charge. 800 mm X 800 mm x 800 mm (into in dimension), 800 mm X 800 mm x 1000 mm (into in dimension), 1000 mm X 1000 mm x 1200 mm (into in dimension from top), 1600 mm X 1400 mm x 2000 mm (into in dimension)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 46 Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing. 800 mm X 800 mm x 800 mm (into in dimension)**

**Item no. 47 800 mm X 800 mm x 1000 mm (into in dimension)**

**Item no. 48 1000 mm X 1000 mm x 1200 mm (into in dimension from top)**

**Item no. 49 1600 mm X 1400 mm x 2000 mm (into in dimension)**

**Scope :-** Unloading, handling, installation, alignment, jointing and grouting of precast concrete elements, including provision of all labour, equipment, lifting gear, temporary supports, and complete in accordance with drawings, specifications, and engineer's approval but including the cost all the building materials required for unloading, handling, installation, alignment and jointing, transportation . 800 mm X 800 mm x 800 mm (into in dimension), 800 mm X 800 mm x 1000 mm (into in dimension), 1000 mm X 1000 mm x 1200 mm (into in dimension from top), 1600 mm X 1400 mm x 2000 mm (into in dimension)

The work is to be executed as per tender specification and use all required material as per Morth & IS code and as per instruction of engineer in charge. Contractor have to execute all require test as per Morth & IS code.

The manufacturer shall have in house product testing facility for box culvert testing for design load capacity.

Mode of measurement and payment: This item shall be measured and paid in RMT basis of completed precast culverts (of required size) installation at site.

**Item no. 51. Providing & laying CC 1:3:6 (1- cement : 3 - coarse sand : 6 - M/c stone aggregate 40 mm nominal size) in foundation concrete incl. machine mixing, ramming, consolidation & curing etc. complete incl. cost of form work etc. complete.**

**Scope :** Providing & laying CC 1:3:6 (1- cement : 3 - coarse sand : 6 - M/c stone aggregate 40 mm nominal size) in foundation concrete incl. machine mixing, ramming, consolidation & curing etc. complete incl. cost of form work etc. complete.

**Materials & Proportions**Mix Ratio: Volumetric proportion of 1:3:6 (1 part Cement : 3 parts Coarse Sand : 6 parts Machine-crushed Stone Aggregate).

**Cement:** Ordinary Portland Cement (OPC 43/53 Grade) or Pozzolana Portland Cement (PPC) conforming to IS 269. Standard PWD Gujarat guidelines calculate nominal cement consumption as per IS code 456.

**Fine Aggregate (Sand):** Clean, sharp coarse river sand or approved M-Sand conforming to IS 383, free from silt, clay, loam, and organic matter. Silt content must not exceed 8% by volume.

**Coarse Aggregate:** Machine-crushed black trap stone aggregate, 40 mm nominal size, well-graded conforming to IS 383. It must be hard, durable, clean, and free from soft, elongated, or flaky pieces.

**Water:** Clean, potable water free from harmful amounts of oils, acids, alkalis, sugars, and organic materials conforming to IS 456.2.

**Formwork (Shuttering)**Material: Steel plates or seasoned timber planks with smooth, watertight joints.

**Erection:** Rigidly braced, propped, and aligned horizontally and vertically to support the weight of wet concrete without sagging or displacement.

**Preparation:** The inside surface of the formwork must be cleaned and coated with an approved release agent (form oil) or soft soap solution before placing the concrete.

**3. Mixing & Placing Concrete**Mechanical Mixing: Concrete must be mixed using a standard mechanical concrete mixer. The aggregates and sand are measured using calibrated volumetric boxes (Farumas).

**Mixing Duration:** Ingredients must be mixed dry first, then water added gradually. The continuous mixing time must be at least 2 minutes until a uniform color and consistency are achieved.

**Foundation Preparation:** The excavated bed must be dressed, leveled, rammed, and lightly watered before concrete placement. Any loose soil, slush, or standing water must be completely removed.

**.Laying:** Concrete must be deposited gently in uniform layers not exceeding 15 cm to 20 cm in thickness. Dropping concrete from a height of more than 1.5 meters is prohibited to prevent segregation.

**.4. Compaction, Consolidation & Finishing**Ramming & Consolidation: Concrete must be thoroughly compacted immediately after laying using mechanical platform vibrators, immersion pin vibrators, or heavy iron rammers until a dense, solid mass is formed and cement slurry creams to the surface.

**.Finishing:** The top surface must be leveled and screeded to the specified level and finished mathematically true with a wooden float.

**Curing & Protection**Initial Protection: Freshly laid concrete must be protected from direct sunlight, heavy rains, and running water.

**Wet Curing:** As soon as the concrete sets initially (usually within 24 hours), the surface must be kept continuously wet by ponding or covering with damp gunny bags.

**Duration:** Curing must continue for a minimum period of 7 to 10 days depending on weather conditions.

Mode of Measurement & Billing Unit of Measurement: The final work is paid by volume, measured in Cubic Meters (cu.m. or m<sup>3</sup>).

**Item no. 52. Providing & laying CC 1:3:6 (1- cement : 3 - coarse sand : 6 - M/c stone aggregate 20 mm nominal size) in plinth wall concrete with weep holes by P/F PVC pipe of 100 MM having 6Kg./Cm<sup>2</sup> pressure & reinforcement as per detailed drawing or as directed incl. machine mixing, vibrating, scaffolding, curing incl. cost of form work but excluding cost of reinforcement etc. complete.**

**Scope :-** Providing & laying CC 1:3:6 (1- cement : 3 - coarse sand : 6 - M/c stone aggregate 20 mm nominal size) in plinth wall concrete with weep holes by P/F PVC pipe of 100 MM having 6Kg./Cm<sup>2</sup> pressure & reinforcement as per detailed drawing or as directed incl. machine mixing, vibrating, scaffolding, curing incl. cost of form work but excluding cost of reinforcement etc. complete

**Materials & Proportions** Mix Ratio: Volumetric proportion of 1:3:6 (1 part Cement : 3 parts Coarse Sand : 6 parts Machine-crushed Stone Aggregate).

**Cement:** Ordinary Portland Cement (OPC 43/53 Grade) or Pozzolana Portland Cement (PPC) conforming to IS 269. Standard PWD Gujarat guidelines calculate nominal cement consumption as per IS code 456.

**Fine Aggregate (Sand):** Clean, sharp coarse river sand or approved M-Sand conforming to IS 383, free from silt, clay, loam, and organic matter. Silt content must not exceed 8% by volume.

**Coarse Aggregate:** Machine-crushed black trap stone aggregate, 20 mm nominal size, well-graded conforming to IS 383. It must be hard, durable, clean, and free from soft, elongated, or flaky pieces.

**Water:** Clean, potable water free from harmful amounts of oils, acids, alkalis, sugars, and organic materials conforming to IS 456.2.

**Formwork (Shuttering)** Material: Steel plates or seasoned timber planks with smooth, watertight joints.

**Erection:** Rigidly braced, propped, and aligned horizontally and vertically to support the weight of wet concrete without sagging or displacement.

**Preparation:** The inside surface of the formwork must be cleaned and coated with an approved release agent (form oil) or soft soap solution before placing the concrete.

**3. Mixing & Placing Concrete** Mechanical Mixing: Concrete must be mixed using a standard mechanical concrete mixer. The aggregates and sand are measured using calibrated volumetric boxes (Farumas).

**Mixing Duration:** Ingredients must be mixed dry first, then water added gradually. The continuous mixing time must be at least 2 minutes until a uniform color and consistency are achieved.

**Foundation Preparation:** The excavated bed must be dressed, leveled, rammed, and lightly watered before concrete placement. Any loose soil, slush, or standing water must be completely removed

**.Laying:** Concrete must be deposited gently in uniform layers not exceeding 15 cm to 20 cm in thickness. Dropping concrete from a height of more than 1.5 meters is prohibited to prevent segregation

**.4. Compaction, Consolidation & Finishing** Ramming & Consolidation: Concrete must be thoroughly compacted immediately after laying using mechanical platform vibrators, immersion pin vibrators, or heavy iron rammers until a dense, solid mass is formed and cement slurry creams to the surface

**.Finishing:** The top surface must be leveled and screeded to the specified level and finished mathematically true with a wooden float.

Curing & Protection Initial Protection: Freshly laid concrete must be protected from direct sunlight, heavy rains, and running water

Wet Curing: As soon as the concrete sets initially (usually within 24 hours), the surface must be kept continuously wet by ponding or covering with damp gunny bags.

Duration: Curing must continue for a minimum period of 7 to 10 days depending on weather conditions.

Mode of Measurement & Billing Unit of Measurement: The final work is paid by volume, measured in Cubic Meters (cum. or m<sup>3</sup>).

**Item no. 53 to 56. Providing & laying controlled cement concrete M - 250 for following RCC works for entrance gate up to any height and finishing smooth incl. machine mixing, vibrating, scaffolding, curing incl. cost of form work but excluding cost of reinforcement etc. complete at any height as directed by engineer in charge RCC COLUMN- up to 4.00 mt, RCC COLUMN- 4.00 to 5 mt, RCC COLUMN- 5.00 to 6.00 mt, RCC COLUMN- 6.00 to 6.50 mt.**

**Materials:**

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Coarse aggregate shall conform M-12 B.

1.2. The shuttering to be provided shall be of ordinary timber planks and shall conform to M-26.

1.3. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

**2.0. General:**

2.1. 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, 1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively.

2.2. The ingredients required for ordinary concrete 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 Kgs. Of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kgs. Of cement maximum.
M-100 (1:3:6)	300 Liters	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to and upper limit of 1:1 ½ and lower limit	34 Liters
M-150 (1:2:4)	220 "		32 "

M-200 (1:1 ½:3)	160 "	1:3	30 "
M-250 (1:1:2)	100 "		27 "

2.3. The water cement ratios shall not more than those specified in the above 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.

2.4. Workability of the concrete shall be controlled by maintaining a water-cement-ratio that is bound to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty with the means available.

2.5. 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 corners of the form.

2.6. For reinforced concrete work, coarse aggregate having a nominal size of 20 mm. are generally considered satisfactory.

2.7. For heavily reinforced concrete members as in the case of 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.

2.8. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be important and the nominal maximum size may sometimes be as great as or greater than the minimum cover.

2.9. 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.

2.10. The form work shall conform to the shape lines and dimension as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding bracing etc. shall be as per design.

2.11. Cleaning & Treatment of forms:

2.11.1. All rubbish, particularly chippings shaving and saw dust shall be removed from the interior of the form before the concrete is placed and the form work in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done, Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil or form oil of approved manufacture may be applied in case steel shuttering is used. Soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforcement bars.

2.12. Stripping time:

2.12.1. In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.:



- |   |                 |
|---|-----------------|
| (a) Sides of walls columns and vertical faces of beam | 24 to 48 hours. |
| (b) Beam soffits. (Props left under)                  | 7 days.         |
| (c) Removal of props slabs                            |                 |
| (i) Slabs spanning up to 4.5 m.                       | 7 days.         |
| (ii) Spanning over 4.5 mm.                            | 14 days.        |
| (d) Removal of props to beams and Arches              |                 |
| (i) Spanning upto 6 m.                                | 14 days.        |
| (ii) Spanning over 6 m.                               | 21 days.        |

2.13. Procedure when removing the form work: 2.4.1. All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffit form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened.

#### 2.14. Centering:

2.14.1. The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behavior of centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

2.14.2. The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.

2.14.3. The centering and form work shall be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to the work, injury to life and damage to property.

#### 2.15. Scaffolding:

2.15.1. All scaffolding, hoisting arrangements and ladders etc. required for the facilitating of concreting shall be provided and removed on completion work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders etc. shall be strong enough to

to act and shall be subject to the approval of the Engineer-in-charge. However, contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.

2.15.2. The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.

2.15.3. The rate is applicable to all conditions of working and height upto 4 mts. The rate shall include the cost of materials and labour for various operations involved such as:

(a) Splayed edges, notching, allowance for overlaps and passing at angles, battens centering, shuttering, strutting, propping bolting, nailing, wedging, easing, striking and removal.

(b) Filletting to form stop chamfered edges or splayed external angles not exceeding 20 mm. widths to beams, columns and the like.

(c) Temporary opening in the forms for pouring concrete, if required, removing rubbish etc.

(d) Dressing with oil to prevent adhesion of concrete with shuttering, and

(e) Raking or circular cutting.

#### 2.16. Re-Use:

2.16.1. Before-re-use, all forms shall be inspected by Engineer-in-charge and their suitability ascertained. The forms shall be scarred, cleaned, and joints gone over, repaired where required. Inside surface shall be retreated to prevent adhesion of concrete.

### 2.0 General:

2.1. The relevant specifications of item No. 5.4.1. of ordinary concrete shall be followed except that the concrete mix shall be designed from preliminary tests, the proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350, & M-400, with prefix controlled added to it. The letter 'M' refers to mix and numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./Cmt.

2.2. The proportion of cement, sand and coarse aggregates shall be determined by weight the weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design.

The strength requirements of different grade of concrete shall be as under:

Grade Of Concrete	Compressive strength of 15 cms. Cubes in Kg./Cmt. At 28 days, conducted in accordance with I.S. 516-1959.	
	Preliminary test Min.	Work test Min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350
M-400	500	400

In all cases, the 28 days compressive strength specified in above table above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for all purposes as concrete belonging to the lower of the two grades between which its strength lies.

### 3.0 Workmanship:

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with means available except where it can be shown to the satisfaction of the Engineer-in-charge, that the supply of properly graded aggregate of uniform quality can be maintained till the completion of work. Grading of aggregate shall be controlled by obtaining the coarse aggregates, in different sizes and being in them in the right proportions as required. Aggregate of different sizes shall be stocked in separate stock piles. The required quantity of

material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags, it shall be weighted separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipments shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge, according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, I.S. 2389 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in concrete shall not be less than 220 Kg/M<sup>3</sup> or as per IS code 456 in plain concrete and not less than 250 Kg/M<sup>3</sup> in reinforced concrete.

4.0. Mode of measurement and payment:

4.1 The rate shall be for a unit of one cubic meter.

**Item no. 57 to 63. Providing & laying controlled cement concrete M - 250 for following RCC works for compound wall & entrance gate up to any height and finishing smooth incl. machine mixing, vibrating, scaffolding, curing incl. cost of form work but excluding cost of reinforcement etc. complete at all levels/any height for (A) FOR RCC FOOTING, (B) RCC PLINTH BEAM, (C) RCC BEAM, (D) RCC COPING, (E) FOR R.C.C. LINTEL, (F) FOR R.C.C. SLAB, (G) FOR R.C.C. CHHAJA.**

**Scope :-** Providing & laying controlled cement concrete M - 250 for following RCC works for compound wall & entrance gate up to any height and finishing smooth incl. machine mixing, vibrating, scaffolding, curing incl. cost of form work but excluding cost of reinforcement etc. complete at all levels/any height for (A) FOR RCC FOOTING, (B) RCC PLINTH BEAM, (C) RCC BEAM, (D) RCC COPING, (E) FOR R.C.C. LINTEL, (F) FOR R.C.C. SLAB, (G) FOR R.C.C. CHHAJA.

## Materials

1.1. Water shall conform to M-1. Cement shall conform to M-1. Sand shall conform to M-2. Grit shall conform to M-8. Coarse aggregate shall conform M-12 B.

1.2. The shuttering to be provided shall be of ordinary timber planks and shall conform to M-26.

1.3. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

### 2.0. General:

2.1. 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, 1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively.

2.2. The ingredients required for ordinary concrete 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	Total quantity of dry aggregate by	Proportion of aggregate to	of fine coarse	Quant ity of
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concrete	volume per 50 Kgs. Of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	aggregate	water per 50 Kgs. Of cement maximum.
M-100 (1:3:6)	300 Liters	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to and upper limit of 1:1 ½ and lower limit 1:3	34 Liters
M-150 (1:2:4)	220 "		32 "
M-200 (1:1 ½:3)	160 "		30 "
M-250 (1:1:2)	100 "		27 "

2.3. The water cement ratios shall not more than those specified in the above 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.

2.4. Workability of the concrete shall be controlled by maintaining a water-cement-ratio that is bound to give a concrete mix which is just sufficiently wet to be placed and compacted without difficulty with the means available.

2.5. 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 corners of the form.

2.6. For reinforced concrete work, coarse aggregate having a nominal size of 20 mm. are generally considered satisfactory.

2.7. For heavily reinforced concrete members as in the case of 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.

2.8. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be important and the nominal maximum size may sometimes be as great as or greater than the minimum cover.

2.9. 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.

2.10. The form work shall conform to the shape lines and dimension as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding bracing etc.

shall be as per design.

#### 2.11. Cleaning & Treatment of forms:

2.11.1. All rubbish, particularly chippings shaving and saw dust shall be removed from the interior of the form before the concrete is placed and the form work in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done, Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil or form oil of approved manufacture may be applied in case steel shuttering is used. Soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforcement bars.

#### 2.12. Stripping time:

2.12.1. In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.:

(a) Sides of walls columns and vertical faces of beam 24 to 48 hours.

(b) Beam soffits. (Props left under) 7 days.

(c) Removal of props slabs

(i) Slabs spanning up to 4.5 m. 7 days.

(ii) Spanning over 4.5 mm. 14 days.

(d) Removal of props to beams and Arches

(i) Spanning upto 6 m. 14 days.

(ii) Spanning over 6 m. 21 days.

2.13. Procedure when removing the form work: 2.4.1. All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffit form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened.

#### 2.14. Centering:

2.14.1. The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behavior of centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

2.14.2. The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.

2.14.3. The centering and form work shall be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to the work, injury to life and damage to property.

#### 2.15. Scaffolding:

2.15.1. All scaffolding, hoisting arrangements and ladders etc. required for the facilitating of concreting shall be provided and removed on completion work by contractor at his own expense. The scaffolding, hoisting

arrangements and ladders etc. shall be strong enough to

to act and shall be subject to the approval of the Engineer-in-charge. However, contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.

2.15.2. The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.

2.15.3. The rate is applicable to all conditions of working and height upto 4 mts. The rate shall include the cost of materials and labour for various operations involved such as:

(a) Splayed edges, notching, allowance for overlaps and passing at angles, battens centering, shuttering, strutting, propping bolting, nailing, wedging, easing, striking and removal.

(b) Filletting to form stop chamfered edges or splayed external angles not exceeding 20 mm. widths to beams, columns and the like.

(c) Temporary opening in the forms for pouring concrete, if required, removing rubbish etc.

(d) Dressing with oil to prevent adhesion of concrete with shuttering, and

(e) Raking or circular cutting.

2.16. Re-Use:

2.16.1. Before-re-use, all forms shall be inspected by Engineer-in-charge and their suitability ascertained. The forms shall be scarred, cleaned, and joints gone over, repaired where required. Inside surface shall be retreated to prevent adhesion of concrete.

## **2.0 General:**

2.1. The relevant specifications of item No. 5.4.1. of ordinary concrete shall be followed except that the concrete mix shall be designed from preliminary tests, the proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350, & M-400, with prefix controlled added to it. The letter 'M' refers to mix and numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./Cmt.

2.2. The proportion of cement, sand and coarse aggregates shall be determined by weight the weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design.

The strength requirements of different grade of concrete shall be as under:

Grade Of Concrete	Compressive strength of 15 cms. Cubes in Kg./Cmt. At 28 days, conducted in accordance with I.S. 516-1959.	
	Preliminary test Min.	Work test Min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350

In all cases, the 28 days compressive strength specified in above table above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for all purposes as concrete belonging to the lower of the two grades between which its strength lies.

### **3.0 Workmanship:**

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with means available except where it can be shown to the satisfaction of the Engineer-in-charge, that the supply of properly graded aggregate of uniform quality can be maintained till the completion of work. Grading of aggregate shall be controlled by obtaining the coarse aggregates, in different sizes and being in them in the right proportions as required. Aggregate of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags, it shall be weighted separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipments shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge, according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, I.S. 2389 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in concrete shall not be less than 220 Kg./M<sup>3</sup> or as per IS code 456 in plain concrete and not less than 250 Kg./M<sup>3</sup> in reinforced concrete.

4.0. Mode of measurement and payment:

4.1 The rate shall be for a unit of one cubic meter.

**Item no. 64 Providing and fixing T.M.T. (Thermo Mechanically Treated) bars confirming to relevant IS Fe 500D grade for R.C.C. works including cutting, bending, binding and placing in position etc. incl. cost of binding wire etc. complete at all level / up to any height .**

#### **Material**

TMT bars conforming to IS 1786 - 1979 with minimum yield strength of 500 N/sq.mm. steel reinforcement for R.C.C. work including bending, binding and placing in position complete up to floor two level.

#### **2 Workmanship:**

2.1 The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed.

2.2 Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting.

- 2.3 Reinforcing steel shall conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be beat 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 transport or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified, 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. In case of bars 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 hooks shall be suitably encased to prevent any splitting of the concrete.
- 2.4 All the reinforcement bars shall be accurately placed in exact position 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 wire 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 support shall not extended to the surface of concrete, except where shown on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast 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 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 protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.
- 2.5 Bars crossing each other where required shall be secured by binding wires (annealed) of size not less than 1 mm. in such manner that they do not slip over each other at the time of fixing and concreting.
- 2.6 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 by concrete 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 movements is maximum.
- 2.7 Whenever 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 joint by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than normal cross - section of the bar. Threads shall be standard threads. Steel for coupling shall conform to I.S. 226.
- 2.8 When permitted or specified on the drawings, joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be 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. Only electric arc welding using a process which excludes air from the molten metal and conform 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 competence welders shall be employed on the work. The M.S. sheet 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.



### 3 Mode of measurement and payments

- 3.1 For the purpose of calculating consumption wastage shall not be permitted beyond 5 percent. Excess consumption over 5% will be charges at panel rate.
- 3.2 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 tones on the same basis of as per M.18 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.
- 3.3 The rate for reinforcement includes cost of steel binding wires its carting from Departmental store to work site. Cutting bending placing binding 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 and spacer bars.
- 3.4 The rate shall be for a unit of One Kg.

**Item no. 65. Brick work using common brunt clay building bricks of class having crushing strength not less than 35 kg/cm<sup>2</sup> for superstructure up to two floor level in C.M. 1:6 (1-cement : 6-coarse sand) incl. racking out joints 20mm deep to expose faces & the joints should be struck flush to expose faces incl. Curing, scaffolding etc. complete.**

#### 1.0. Materials

Bricks shall conform to M-15. Cement mortar shall conform to M-11.

#### 2.0. Workmanship

##### 2.1. Proportion:

- 2.1.1. The proportion of the cement mortar shall be 1:6 (1 cement: 6 sand) by volume.

##### 2.2. Wetting of bricks:

- 2.2.1. The bricks required for masonry shall be thoroughly wetted with clean water for about two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is as indication of through wetting of bricks.

##### 2.3. Laying:

- 2.3.1. Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete to bond; closures in such case shall be cut to required size and used near the ends of walls.
- 2.3.2. 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 tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.
- 2.3.3. The walls shall be taken up truly in plumb. All courses 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.

- 2.3.4. The brick shall be laid with frog 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.
- 2.3.5. 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 steeper than 45 degrees.
- 2.3.6. All futures, pipes, outlets of water, hold fasts of doors and windows etc. which are required to be built in wall shall be embedded in cement mortar.

#### **2.4. Joints:**

- 2.4.1. 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 tools daily during the progress of work, when the mortar is still green so as to provide key for plaster or pointing to done.
- 2.4.2. The face of brick shall be cleaned the very day on which the work is laid and all mortar dropping removed.

#### **2.5. Curing:**

- 2.5.1. 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.

#### **2.6. Preparation of foundation bed:**

- 2.6.1. If the foundation is to be laid directly on the excavated bed, it shall be leveled, cleared of all loose materials, cleaned and wetted before stating 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.
- 2.7. The frames of doors, windows, cupboards etc. shall be housed into the brick work at the correct location and level as directed. The heavy steel doors, window frames etc. shall be built in with work, but for ordinary steel doors and windows required opening for frames, hold-fasts, etc., shall be in the wall and frame embedded later on in order to avoid damage to the frames.
- 2.8. 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 coarse only. Minimum number of holes be left in brick 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.
- 2.9. For the face of brick work, where 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.

#### **3.0. Mode of measurements & payment**

- 3.1. The masonry work of G.F. i.e. above plinth level to floor two level shall be measured and paid under this item rate includes cost of all materials.
- 3.2. Brick work in parapet shall be included in the corresponding masonry item of floor immediately below the floor above which the parapet is built.

**3.3.** No deduction shall be made from quantity of brick work nor any extra payment made for embedding in masonry of marking holes in respect of following item.

(1) Ends of joints, beams, posts, girders, rafters, purlins trusses corbel, steps, etc. where cross sectional area does not exceed 500 sq.cm.

(2) Opening not exceed in 1000 sq.cm.

(3) Wall plate sand bed plates bearing of slab, chhajjas, and like whose thickness does not exceed 10 cms. and the bearing does not extend the full thickness of wall.

(4) Drainage holes and recesses for cement concrete blocks to embed hold fasts for doors, window etc.

(5) Iron fixtures, pipes up to 300 mm. dia. hold fasts of doors, and window built into masonry and pipes etc. for concealed wiring.

(6) Forming charges of section not exceeding 350 sq.cm. in masonry.

(7) Apparatuses for fire places shall not be deducted nor shall extralabourrequired to make splaying of jumps, throating and making trenches over the aperture be paid for separately.

**3.4. The rate shall befor a unit of one cubic meter.**

**Item no. 66 . Providing & Laying 20mm thick sand faced plaster on wall up to any height consisting of 12mm thick backing coat of cement mortar 1:3 (1-cement : 3 - sand) & 8mm thick finishing coat of cement mortar 1:1 (1-cement : 1-sand) incl. Scaffolding, curing, etc. incl. racking out joints, cleaning etc. complete.**

20 mm. thick cement plaster in double coat on rough side of single or half brick wall for interior plastering upto floor two level, 1<sup>st</sup> coat plastering comprising of base coat of 12 mm thick cement plaster in cement mortar (1 cement:4 coarse sand) in rough finishing and 8 mm thick top coat of cement mortar 1:3 (1 cement :3 coarse sand) finished with trowel including scaffolding curing etc comp.

**1.0. Materials & Workmanship : 1.1.** The relevant specifications of item No. 17.59 (III) shall be followed except that

thickness of plaster shall be 20 mm. consisting in two coats 1<sup>st</sup> coat shall be 12 mm thick in C: 1:3 and 2<sup>nd</sup> coat 8 mm thick in CM 1:1.

**2.0. Mode of measurements & payment:**

2.1. The relevant specifications of item No. 17.59 (I) shall be followed.

2.2. The rate shall be for a unit of one sq. metre.

17.69. Extra over item 58 to 64 for finishing with a floating coat of net cement slurry.

**1.0. Materials & Workmanship :**

1.1. The relevant specifications of item No. 17.58 and 17.61 shall be followed for materials and workmanship except that this work is only of providing smooth cement finish with foloating coat of neat cement slurry.

1.2. The coat of cement and fine sand mortar of proportion 1:1 (1.5. rnm. thick about) shall be applied to the plastered surface with a trowel to provide uniform texture while the base coat is still plastic.

1.3. In any continuous face of wall the finishing treatment should be carried out continuously and day to day break made to coincide with architectural breaks in order to avoid unsightly junctions.

1.4. Curing : All the plaster work shall be kept damp continuously for a period of 7 days.

## **2.0. Mode of measurements & payment:**

2.1. The payment shall be made for a unit of 1.0 sq. mt. of work done over and above the finishing of work of base coat.

2.2. The-relevant specifications of item of base coat shall be followed for measurements and payment.

2.3. The rate shall be for a unit of one sq. metre.

**Item no. 67 Providing & Laying 15 mm thick cement plaster in single coat in CM 1:3 (1-cement : 3-sand) on rough & fair side of stone / brick masonry / concrete surface for interior & exterior plastering up to any height incl. drip moulding & finished even and smooth with neat cement slurry incl. racking out joints, cleaning etc. complete at all levels/ up to any height.**

### **1 MATERIALS:**

Cement shall conform to M-3 of attached Specification of Materials.

Sand shall conform to M-6 of attached Specification of Materials.

Cement mortar in proportion 1:3 (1-cement : 3 coarse sand) shall conform to M-9 of attached Specification of Materials.

Water shall conform to M-1 of attached Specification of Materials.

### **2 WORKMANSHIP :**

Plastering work shall be carried out as per C-31 of attached code of practice & IS :1661-1972.

For scaffolding, relevant specification of C-9 of attached code of practice shall be followed

### **3 MODE OF MEASUREMENT & PAYMENT :**

The measurement shall be taken on the Sq. Meter basis as per I.S. 1200-XII- 1976 or as revised from time to time so far as applicable.

The contract rate shall be for a unit of one Sq. Meter of plastering of specified thickness.

**Item no. 68 Applying wall painting three coats with plastic emulsion paint of approved brand and manufacture on wall surface to give an even shade with applying two coat ready made putty of approved quality including thoroughly brushing the surface free from mortar droppings & other foreign matter & sand papered smooth etc. comp at all levels / up to any height.**

## **1 Materials**

1.1 The water shall conform to M-1. Plastic emulsion paint shall be of standard quality as approved by engineer incharge..

## **2 Workmanship**

2.1 Scaffolding the relevant specification of item No. 18.11 shall be followed.

2.2 Preparation of surface: The relevant specifications of item No. 18.11 shall be followed except that the work white wash colour wash shall be submitted with Weather proof paint.

2.4 Application of paint: **as per manufacturers specifications for application of paint.**

2.4.1 No painting shall be done when the paint is likely to be exposed to a temperature of below 7.0°C with 48 hours after application.

2.4.2 When weather conditions are such as to cause damage the work shall be carried out "in the shadow" as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

2.4.3 To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.

2.6 Protection measures shall be taken as per item No. 18.11 para 2.6

### **3 Mode of measurements & payments**

3.1 The relevant specifications of item shall be followed.

3.2 The rate shall be for a unit of one sq.metre.

**Item no. 69 External wall painting (two coats + priming coat) with APEX weather proof exterior emulsion paint of Asian paints or equivalent as approved and of required shade up to any height including a priming coat of primer of approved brand and manufacture on wall surfaces to give an even shade after thoroughly brushing the surface & making the surface free from mortar droppings and other foreign matter and sand papered smooth incl. filling the all small holes, cracks, open joints, undulations and similar other minor defects of every kind with ready made putty of approved brand and manufacture and rubbed smooth with sand paper incl. necessary scaffoldings etc. complete at all levels / up to any height.**

**1.0. Materials :** Water shall be conform to M-I. The plastic emulsion shall conform to I.S. 5411-1969 (part-I).

#### **2.0. Workmanship:**

2.1. Scaffolding : The relevant specifications of item No. 18.11 para 2.1. shall be followed.

2.2. Preparation of surface : The relevant specifications of item No. 18.44 para 2.2. shall be followed.

2.3. Preparation of Mix : This shall be done as per manufacturers instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added shall be as per manufacturer instructions.

#### **2.4. Applications:**

2.4.1. Before pouring into small containers for use, the paint shall be stirred thoroughly in its container. When applying also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.

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

2.4.3. The paint shall be applied with brush or rollers. For undecorated surfaces, the surface shall be treated with minimum two coats of cement water proofing paint. The second or subsequent coat shall not be started until the preceeding coat has become sufficiently hard to resist marking by brush being used.

2.4.4. The surface on finishing shall present a flat velvety smooth finish. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

## **2.5. Precautions:**

(a) Old brushes if they are to be used with emulsion paints, shall be completely dried of turpentine oil paint by washing in warm soap wafer. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall bi cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application.

**2.6. Protective measures:** 2.6.1. The relevant specifications of item No. 18.17. para 2.3. shall be followed:

## **3.0. Mode of measurements & payment:**

3.1. The relevant specifications of item No. 18.11 shall be followed.

3.2. The ,ate shall be for a unit of one sq. metre.

4.2 The rate shall be for a unit of one cum.

**Item no. 70 Providing & filling in foundation & plinth with sand brought from outside in layers of 20 cm. thickness incl. watering, ramming and consolidating etc. complete.**

## **1.0.Material**

### **SAND FILLING**

#### **1. Sand**

Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV or V specified in section 3 'Mortars'.

#### **2 Filling**

Sand filling shall be done in a manner similer to earth filling in plinth specified in except thatconsolidation shall be done by flooding with water. The surface of the consolidated sand filling shallberessed to the required level or slope and shall not be covered till the Engineer-in-charge has inspected and approved the sand filling.

#### **3. Measurements**

The length, breadth and depth of consolidated sand shall be measured with steel tape correct to the nearest cm and cubical contents worked out in cubic metres correct to two places of decimal.

#### **4. Mode of Measurements and Payment:-**

The rates include the cost of material and labour involved in all operations described above.

- 4.1 The work shall be measured for finished item in cum. based on actual thickness measured on site after watering and consolidation.

- 4.2 The rate shall be for a unit of one cum.

**Item no. 71 Providing & fixing 35 MM thick door shutter incl.teak wood door frame 10 X 7 cm consisting of solid core single or double leaf flush door shutter of 30 MM thickness, lipped with 15 mm (5MM x 3) thick x 30 mm width on stiles & top rails and 10 mm(5 mm x2) other stiles and bottom rails. The inner panel laminated with 2 mm thick termite proof, water proof & fire resistant moulded PVC sheet with 2,4,6 raised panel design in different plain and/ or pre laminated colour on one side after routing the moulded design on flush door & 2 MM plain and/ or pre laminated PVC sheet on other side using rubber adhesive on flush door and solvent cement adhesive on the PVC lapping incl. prov. & fixing stainless steel matt fixtures, fasteners and lock as per the detailed drawing etc. complete at all level. Fully paneled**

**(e) MATERIALS:**

The flush door shutter shall be of approved make (List of approved make attached with Technical Bid) and generally conform to **M-51** of Specification of Materials attached herewith.

First class teak wood beading of required size shall be of best quality as approved and uniform shade and colour.

2mm thick termite proof, water proof & fire resistant moulded PVC sheet shall be of best quality, approved make & shade.

Wood primer shall be have approved make (List of approved make attached with Technical Bid) and shall conform to **IS: 3536-1966**.

Synthetic enamel paint shall be of approved make (List of approved make attached with Technical Bid) and shall conform to **M-24/B** of Specification of Materials attached herewith.

The stainless steel matt fixtures, fasteners and lock shall be of approved quality & approved (List of approved make attached with the technical Bid) & generally conform to **M-23** of Specification of Materials attached herewith.

The relevant specification of **IS: 2202** shall be followed.

**(f) WORKMANSHIP :**

The work of shutter shall be carried out as per standard code of practice.

The relevant specification of **C- 12 & C-56** of Code of practice attached herewith shall be followed except that work is to be carried out for flush shutter with laminated PVC sheet on both sides and first class teak wood beading of required size on all faces of shutters.

The work of flush shutter shall be carried out as per given detailed drawing. Fixing work of laminated PVC sheet on other side shall be carried out as directed by the Engineer-in-charge and standard code of practice.

The fixing of teak wood beading on all faces of flush shutter shall be carried out in a best workmanship like a manner and standard code of practice.

Painting work shall be carried out as per **C-15** of Code of practice attached herewith.

Fixtures and fasteners shall be fixed to door as per **C-13** of Code of practice attached herewith. Or as directed by

the Engineer-in-charge truly workmanship like manner to give easy operation.

The work shall be executed in accordance with best modern practices.

The entire work shall be carried out in best workmanship like manner & as directed.

**(g) MODE OF MEASUREMENT & PAYMENT :**

The measurement shall be taken on the Sq. Meter basis as per IS : 1200 or as revised from time to time so far as applicable

**The contract rate shall be for a unit of one Sq. Meter of flush door shutter area exclusive of door frame, out to out measured and the height shall be measured from the finished floor level as per IS : 1200.**

**Item no. 72 Providing and fixing Aluminium Section (Colour anodized of minimum 15 micron thick) fixed in composite panel of Alluminium window outer frame of size 63mmx 38mm x 1.5 mm, with three track sliding shutter (3/4 series shutter section) fixed with glazing section using 5 mm thick best quality plain sheet glass of approved colour with P/F all necessary fixtures, fasteners & window accessories like Handles, hinges, screws, Lock, bearing, stopper etc. as may be needed and as directed by Engineer in Charge etc. complete at all levels.**

**General**

This work shall consist of **Providing & fixing in position standard extruded Aluminum Four track Window**, of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge

**MATERIAL**

**Aluminum standard section**

**Specification no M-31 from specification booklet** for Building works

All section shall have finished luster surface on all sides and Quality shall be equivalent to Jindal Product

Outer frame sections shall be of **Three track**

Aluminum alloy used in the manufacture of extruded Door section shall confirm to I S designation HEA-WP of I S 733-1975 and also Designation WVG -WP of I S 1285-1975 section shall be as specified in the drawing and design.

All sections shall be Free from any scratches or holes or any damages on surface. All section shall have finished luster surface on all sides size and weight of the Members shall be as describe in Item

**SS mosquito net**



**Specification no 10.51 (2.2) from specification booklet** for Building works Shall confirm 85 G wire net of .56 mm dia

This Styles rails ect shall be reveted 12mm along the side where they receive the gauge the stainless steel webbing of 0.56 mm dia mesh shall be used unless otherwise specified the webbing shall be at 90 to 12mm along both side of the rebate and fixed securely and neatly to the Frame

### **5 mm thick colour tinted glass**

**5 mm thick colour tinted glass Specification no M-38 from specification booklet for Building works** except the glass shall be colour tinted of approved brand and colour and thickness

The glass shall be of approved make having thickness of 5 mm The glass shall be clear and free from scratches and cracks The glass shall be provided on the top

### **Glassing clips**

Glazing clips shall be of size 19.00 x 17.00 mm. shall be Free from any scratches or holes or any damages on surface. All section shall have finished luster surface on all sides

### **Rubber Gasket**

Rubber gasket shall be of approved make. shall be Free from any scratches or holes or any damages on surface. and shall have finished luster surface on all sides

### **Fixtures**

Specification no M-43 from specification booklet for Building works for fixture and fastening shall be applied for this item

### **Handles,**

handles shall be of approved make. shall be Free from any scratches or holes or any damages on surface. and shall have finished luster surface on all sides

### **Bolts,**

All bolts shall be of approved make. shall be Free from any scratches or holes or any damages on surface. and shall have finished luster surface on all sides

### **WORKMANSHIP**

The Work of aluminum door shall be done with extreme finishing. The partial board shall be fixed in the bottom panel and glass shall be fitted on top panel as directed by Engineer in charge using glazing clips and rubber gaskets

as required All the fixtures and fastenings shall be fitted at right place and as directed by Engineer in charge. Floor spring shall be fitted properly so as to align the door properly and shall be given trial of opening and closing properly.

#### **Mode of Measurement & Payment :**

The Item shall be measured for its **breadth and height** limiting dimensions to those specified on plan or as directed. The rate shall be for a unit of one square meter.

The payment will be made on square Meter basis of the finished work.

The rate shall be for a unit of **one square meter**

**Item no. 73 Providing and laying Vitrified tiles 8 to 10 mm thick ,24" x 24" in flooring treads of steps and landing laid on a bed of 12mm thick cement mortar 1:3 (1-cement : 3-coarse sand ) finishing with flush pointing in white cement.**

#### **Ceramic Tiles**

The tiles shall be of best quality as approved by the Engineer-in-charge. They shall be flat and true to shape. They shall be free from craks, crazing, spots, chipped edges and corners. The glazing shall be of uniform shade.

The tiles shall be nominal size of 250 to 450 mm unless otherwise specified. The maximum variation from the stated sizes, other than the thickness of tile, shall be plus or minus 1.5 mm. The thickness of tile shall be 12 mm. Except as above the dies shall conform to I.S. 777 1970.

**Laying :** The surface of sub grade shall be cleared wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one vetrified tiles. The ceramic tiles shall be washed clean before laying. It shall be laid on top pressed and tapped gently to bring it in level with other ceramic tiles. It shall then be lifted and laid a side. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows, or depressions. The mortar shall then be allowed to harden it over this surface cement slurry of honey like consistency at 4.4 Kg. of cement per sq. metre. The edges of ceramic tiles already paved shall be buttered with grey cement. The ceramic tiles shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining ceramic tiles. The joints shall be as fine as possible: Surplus cement on the surface of the ceramic tiles shall be removed. The ceramic tiles fixed in the floor adjoining the walls shall enter not less than 10 mm. under the plaster skirting or dado. The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

**Curing :** The tiles shall be cured for a minimum period of seven days.

**2.6. Polishing and finishing:** Uncveness at the meeting edges of tiles shall be removed by fine chiselling. Finishing etc. shall be done as per relevant specifications of item No. 14.21 (A) of terrazo tiles flooring except that cement slurry with/ or without pigments shall not be applied on the surface before each polishing.

Mode of measurements & payment:

Ceramic Tiles flooring with various kinds of ceramic tiles shall be measured in sq. metre. The length and breadth shall be measured between the finished face of skirting or dado or wall plaster. No deduction shall be made nor extra shall be paid for any openings in the floor of area upto 0.05 sq. mt. Nothing extra shall be paid for laying ceramic at different levels in the same room.

3.2. The rate shall be for a unit of one sq. metre.

**Item no. 74 Providing and laying broken chine mosaic flooring for terrace using 12 mm to 20 mm broken pieces of glazed tiles to be laid over cement mortar 1:3 to plain or slope and to be tempered to bring mortar creme out upto surface using white cement including rounding off junctions and extending them upto 15 cm along the wall,clearing with water and oxalic acid etc. as directed.After finishing the whole terrace shall be flooded with water for a period of two weeks.**

#### **1.0 Workmanship:**

**1.1.** The existing R.C.C. surface of slab shall be cleaned thoroughly.

**1.2.** Applying and grouting a slurry coat of neat cement using 2.75 kg/sqm. of cement admixed with proprietary water proofing compound conforming to IS 2645 over the R.C.C. slab

**1.3.** Laying cement concrete using broken bricks/brick bats 12mm to 20mm size with 50 % of cement mortar 1:3 (1 Cement : 3coarse sand) admixed with proprietary water proofing compound conforming IS 2645. over 20mm thick layer of C.M 1:3 (1 Cement : 3coarse sand) admixed with proprietary water proofing compound conforming to IS 2645 to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

**1.4.** After two days of proper curing, applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS 2645.

#### **2.0 Mode of Measurement and Payment:**

**2.1.** The rate shall be paid per cubic meter.

**Item no. 75. Providing & fixing M.S. plain grills of required pattern to window's gapes etc. with M.S. flats & 12mm square bright bar at required spacing & frame around, square with round headed bolts, nuts, or by screws built up section frame work incl. all necessary materials and labour incl. one coat of priming coat of red lead paint and two coat of enamel paint etc. comp.**

**Scope:** Providing & fixing M.S. plain grills of required pattern to window's gapes etc. with M.S. flats & 12mm square bright bar at required spacing & frame around, square with round headed bolts, nuts, or by screws built up section frame work incl. all necessary materials and labour incl. one coat of priming coat of red lead paint and two coat of enamel paint etc. comp.

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per Kg.

**Item no. 76 Providing & fixing on wall PVC rain water pipes of 110 mm diameter of 6Kg./Cm2 incl. bend, Tee etc. incl. jointing materials incl. fixing with necessary clamps to walls etc. as directed at all level.**

Scope: Providing & fixing on wall PVC rain water pipes of 110 mm diameter of 6Kg./Cm2 incl. bend, Tee etc. incl. jointing materials incl. fixing with necessary clamps to walls etc. as directed at all level.

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per RMT.

**Item no. 77 Steel work, riveted in built up sections framed work including cutting, hoisting, fixing in position and applying a priming coat of read lead paint.**

**Scope :-** Steel work, riveted in built up sections framed work including cutting, hoisting, fixing in position and applying a priming coat of read lead paint.

**1 Materials:**

1.1 The structural steel shall conform to M-22.

**2 Workmanship:**

2.1 The M.S. grill shall be prepared as per the drawings or as directed for fixing to wooden frames of windows etc.

2.2 The grill shall be fabricated to the designs and patterns shown in the drawings and the weight shall be as directed, and the joints shall be riveted or welded as shown in the plan or as directed. The grill so formed shall be fixed into the frames of the windows etc. before they are erected in position. The outside strip frame of the grill shall be housed to its full thickness into the recess cut into the frame of the windows etc. The grill shall be fixed to the frame with number of bolts and nuts of screws viz. bolts nut / screws per 30 cms. of the length of outer strip subject to a minimum of 2 Nos. of each side of the frame or as indicated in the drawings or as directed.

2.3 The bolts and nuts or screws shall be counter sunk and shall be fixed with the top of their heads flush with the face of frame strips.

1.1. The relevant specification of item No. 11.2 (A) shall be followed except that the steel work shall be done by welding.

1.2. Welding shall generally be done by electric process. Gas welding shall be resorted to, using oxyacetylene flame with specific prior approval. Gas welding shall not be permitted for structural steel work.

1.3. The work shall be done as shown in the shop drawings which should clearly indicate various details of the

oints to be welded, shop and site welded as well as type of electrodes to be used, symbol for welding on plans and shop drawings shall be according to I.S. 813-1961. As far as possible every effort shall be made to limit the welding that must be done after improper welding that is likely to be done due to heights and difficult positions on scaffoldings etc. The welding work shall conform to I.S. 816-1969.

- 1.4. Preparation of surfaces : Surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.
- 1.5. Assembly for welding : Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the plates accurately in place without displacement.
- 1.6. Precautions : All operations connected with welding and cutting equipment shall conform to safety requirement given in I.S. 818-1968.
- The following points shall be borne in mind during the process of welding:
- (b) Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.
- (c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.
- 1.7. The defective welds which shall be considered harmful to the structural strength shall be cut out and reworked.
- 1.8. Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed. Welds and adjacent parts shall also be painted after they are approved.
- 1.9. All the members shall be thoroughly cleaned of rust-scales, dust etc. and given a priming coat of red lead paint before fixing them in position.
- Testing of welding to be added in the specification I.N. 12.2.2.12-(i) to (viii)

### **3 Mode of measurements & payment:**

- 3.1 No payment shall be made for weight of screws, bolts, nuts etc. only weight of grill shall be paid.
- 3.2 The rate shall be for a unit of Quintal.

**Item no. 78 Providing and fixing in wall, ceiling and floor galvanized mild steel tubes (Heavy grade) of the following nominal bore, tube, fittings and clamps including making good the wall, ceiling and floor etc. complete at all floor levels (F) 50mm**

**Scope :-** Providing and fixing in wall, ceiling and floor galvanized mild steel tubes (Heavy grade) of the following nominal bore, tube, fittings and clamps including making good the wall, ceiling and floor etc. complete at all floor levels (F) 50mm

The contractor has to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor has to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per RMT.

**Item no. 79 Providing and fixing sliding iron estate gate as per design and given drawing with top & bottom rails of T iron of required size with required dia. Steel pulleys complete with bolts nuts, locking arrangements, stoppers, holdfasts, handles, aldrops etc. incl. cost of welding, cutting etc. using the M.S. pipes (Heavy duty), angles, flats etc. as per drawing incl. fixing in RCC. column etc. incl. applying a priming coat of red lead paint and three coats of approved synthetic enamel paint etc. complete**

**Scope :-** Providing and fixing sliding iron estate gate as per design and given drawing with top & bottom rails of T iron of required size with required dia. Steel pulleys complete with bolts nuts, locking arrangements, stoppers, holdfasts, handles, aldrops etc. incl. cost of welding, cutting etc. using the M.S. pipes (Heavy duty), angles, flats etc. as per drawing incl. fixing in RCC. column etc. incl. applying a priming coat of red lead paint and three coats of approved synthetic enamel paint etc. complete

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per Quintal.

**Item no. 80 Providing and fixing Digitally printed steel GIDC Logo for entrance gate.**

**Scope :-** Providing and fixing Digitally printed steel GIDC Logo for entrance gate

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per No.

**Item no. 81 Providing and fixing Digitally printed steel Letters for entrance gate.**

**Scope :-** Providing and fixing Digitally printed steel Letters for entrance gate.

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per No.

Item no. 82 **Painting two coats (excluding priming coat) on new steel and other metal surface with enamel paint, brushing, interior to give an even shade including cleaning the surface an even shade including cleaning the surface of all dirt, dust and other foreign matter**

**Scope :-** Painting two coats (excluding priming coat) on new steel and other metal surface with enamel paint, brushing, interior to give an even shade including cleaning the surface an even shade including cleaning the surface of all dirt, dust and other foreign matter

The contractor have to use material as per tender specification, as per IS code, Morth and as per instruction of engineer in charge.

The contractor have to execute work as per IS code, Morth and as per instruction of engineer in charge.

The item rate is including loading, unloading, transportation, material cost, labour cost etc.

**Mode of Measurement and Payment:**

The rate shall be paid per Sqmt.