

GENERAL TECHNICAL SPECIFICATIONS FOR ROAD WORK

NAME OF WORK _____

_____ **DEPARTMENT**

_____ **CIRCLE**

_____ **DIVISION**

_____ **20**

**General Technical
Specifications
for
ROAD WORK**

GENERAL TECHNICAL SPECIFICATIONS FOR ROAD WORKS

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GENERAL TECHNICAL SPECIFICATIONS

1.0 General :

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with General Conditions of Contract. The same shall not however apply in the case of lump-sum items. All measurements and computations, unless otherwise indicated, shall be carried nearest to the following limits:

- (i) length and breadth 10mm
- (ii) height, depth or thickness of earthwork,
sub-base, bases, surfacing, and structural members 5mm
- (iii) areas 0.01 Sq. Metre
- (iv) cubic contents 0.01 cubic metre

in recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

2.0 Measurement of lead for Materials :

Where lead is specified in the contract for construction materials, the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regard shall be taken as final. Distance upto and including 100 metres shall be measured in units of 50 metres, exceeding 100 metres but not exceeding 1 KM. in units of 100 metres, and exceeding 1 km. in units of 500 metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the material shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

3. Surface Regularity of Subgrade & Pavement Courses :

The surface regularity of completed sub-base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10 metres.

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr.	Type of Construction	Longitudinal Profile with 3 metre straight edge				Cross Profile	
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m. length exceeding in mm				Maximum permissible variation from specified profile camber template - mm
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earth Subgrade	36	30	-	-	-	15
2.	Granular / lime / Cement Stabilised sub-base	23	-	30	-	-	12
3.	Water Bound Macadam with nominal size metal (20-50) mm	18	-	-	30	-	8
4.	Semi-Dense Carpet @@	15	-	-	-	20	6

Notes :

- @@ These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance upto 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.

2. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3. **Rectification** : Where the surface irregularity of subgrade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

(i) **Subgrade** : Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) **Granular/Sub-base** : Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) **Lime/Cement stabilized soil sub-base** : For Lime/Cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material, is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material, to specification. In either case, the area treated shall not be less than 5 metres long by 2 metres wide. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) **Water Bound Macadam Base** : Where the surface is high or low, the top 75mm shall be scarified, reshaped with added material as necessary and recompacted. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

(v) **Bituminous Constructions** : For bituminous constructions, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and recompaction to specifications. Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metre long and not less than 1 lane wide.

4. **Quality Control Tests During Construction :**

The materials supplied and the works carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out test as frequently as he may deem necessary to satisfy that the materials at work comply with the appropriate specifications. Test procedures for the various quality control tests are indicated in the respective sections of the specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per prevalent accepted engineering practice to the directions of the Engineer-in-charge.

5. **Tests on Earthwork for Embankment Construction :**

5.1 **Borrow Material :**

- (a) **Sand Content (IS : 2720 Part IV)**
Two test per 8000 Cubic Metres of soil.
- (b) **Plasticity Test (IS : 2720 Part-V)**
Each type to be tested. Two tests per 8000 Cubic Metres of soil.
- (c) **Density test (IS : 2720 Part VII)**
Each soil type to be tested. Two tests per 8000 Cubic Metres of soil.
- (d) **Moisture Content Test (IS : 2720 Part-ID)**
One test for every 250 Cubic Metres of soil.

5.2 **Compaction Control :**

Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted

area, or closer as required to yield the minimum number of test results for evaluating day's work on statistical basis. The determination of density shall be in accordance with IS : 2720 (Part XXVIII). 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 a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compactions is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the subgrade, at least one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the tests in each set of measurement shall be at least 10. In other respects, the control shall be similar to that described earlier.

6. Following materials shall conform to the Indian Standards shown against them :

- (1).... Cement..... IS : 269
 (2).... Sand for masonry..... IS : 2116
 (3).... Sand for concrete..... IS : 383
 (4).... Coarse aggregate..... IS : 383
 (5).... Mild Steel..... IS : 432
 (6).... High yield strength deformed bars
 (a) Hot Rolled..... IS : 1139
 (b) Cold Twisted..... IS : 1786

7. Barrel thickness of pipes of different class shall be as under :

Sr. No.	Internal Diameter of pipe in mm	Barrel thickness (in mm)		
		NP1	NP2	NP3
1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

Annexure : A. TECHNICAL REQUIREMENTS OF HOT MIX PLANT

Composition of plant : The Hot Mix Plant shall conform generally to IS Specifications No. IS 3066/ 1965 as amended from time to time and shall be equipped with the following arrangements :

- 1. Cold Aggregate Feeder :** The cold aggregate feeder shall have minimum three independent bins or compartment, each provided with accurate mechanical pre-determined rate to the cold elevator or to some intermediate conveyor or directly into the dryer. The feeder shall provide for the adjustment of total and proportional feed and shall be capable of being locked in any setting.
- 2. Dryer :** The dryer shall be capable of continuously agitating the aggregates while heating to the desired temperature. At the discharge end of the dryer or any other suitable location, means shall be provided for ascertaining the temperature of the heated aggregate.
- 3. Screening Unit and Gradation Control :** The dried aggregate shall be screened into not less than three size. The plant shall include means for accurately proportioning each bin size of aggregate either by weight or volumetric measurement. When the gradation control is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled, individual gate to form an orifice for proportioning the material drawn from each respective bin compartment. The orifice shall have positive mechanical adjustment and provided with a lock. Indicators shall be provided on each gate to show the opening in centimeters.
- 4. Mixer Unit :** The plant shall include a mixer of an approved twin shaft pugmill type capable of producing a uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of fines.
- 5. Mineral Filler Supply Unit :** There shall be an independent arrangement to feed mineral filler directly into the pugmill. The hopper to bin for mineral filler shall provide for the adjustment to proportion the feed with the aggregate and bitumen feeds and shall be capable of being locked in any setting.
- 6. Bitumen Heating :** A heating system for bitumen always with effective and positive control of temperature shall be provided, to maintain proper temperature and for allowing continuous circulation between storage tank and proportioning units during the entire operating period. Suitable arrangements shall be provided for recording the temperature at the tanks and in the circulating system.
- 7. Synchronization :** For Synchronization of Aggregate, Bitumen and filler feeds satisfactory means shall be provided to afford positive inter-locking control between the flow of aggregate from the bins or compartment, flow of bitumen from the tank and flow of mineral filler.

Special Conditions for Bituminous surface work with use of Hot Mix Plant paver Finisher.

- The Hot Mix Plant and accessories to be used for the work shall be in conformity with the specifications prescribed vide Govt. of India, Ministry of Transport Circular No. RQ/RMP/1613784 dt.1-1-87. The plant shall be equipped with all units and accessories as per latest I.S. 3066/1965, as amended from time to time. The Contractor will have to modify their plants suitably within a period of six months from the date of issue of latest I.S. Specification or Codes.
- The work of laying aggregate mixed with bitumen shall start on site of work only after 8.00 hours in the morning and continue upto 17.00 hours in winter season and upto 18.30 hours in summer. No work shall be done except during the period mentioned above and also on Sundays and National holidays viz. 26th January, 15 the August & 2nd October.
- Quantity of bituminous aggregate mix to be laid shall be restricted to 250 tonnes per day for 30/40 capacity plant and may be more or less depending upon the rated capacity of the plant.
- The work of laying asphalt mix shall start latest within 60 days from the date of issue of work order except when work is closed for few days due to breakdown of machinery and during such period the contractor has not shifted paver plant to any other paver work not carried out by the same plant and will be completed as per time limit. Reasons for delay in starting of work after 60 days shall result into sufficient cause for levying compensation for disproportionate progress. However, the period from 15th June to 15th October monsoon shall not be counted for the purpose of disproportionate progress and consequent cause for levy of compensation. The contractors shall commence the work of laying pavement on or before the last date of the period mentioned above failing which he shall pay for every day that he shall delay the commencement of the work as above in accordance with clause-2 of the contract.

કોન્ટ્રાક્ટર ૬૦ દિવસની અંદર કામ શરૂ કર્યા પછી ઘોડુંક કામ કરીને નીચે દર્શાવેલ સંજોગો સિવાય કામ અધુરા મુકશે તો જે દિવસથી કામ અધુરું મુકે તે દિવસથી કામ શરૂ કરે ત્યાં સુધી રૂ. ૫૦૦/- લેખે વળતર વસૂલ કરવામાં આવશે.

- (૧) મશીનરી બ્રેકડાઉન થયેલ હોય અને તેટલા જ જુજ સમય પુરતું કામ બંધ રહેલ હોય.
- (૨) મશીનરી બ્રેકડાઉન સમય દરમિયાન પેવર પ્લાન્ટ પણ ત્યાંથી ખસેડવામાં આવેલ ન હોય અથવા તે જ પ્લાન્ટ પેવરથી અન્ય જગ્યાએ કામગીરી કરવામાં આવી ન હોય.
- The Contractor shall invariably get the job mix formula for the mix approved by the Engineer-in-charge before starting the work.
- These special conditions shall be applicable to the specifications of all the items included in this contract where work is to be carried out with Hot Mix Plant and paver finisher.
- No asphalt work shall be executed in monsoon as per condition 4. However in critical circumstances asphalt work may be executed during monsoon with permission of Superintending Engineer who may give permission after ascertaining the proportion of moisture in existing surface & atmosphere (R & B.D. G.R. dated 24-10-94 & No. S.S.R-102004 (23)-C dated 23-6-2004).

SCHEDULE OF WORK TO BE EXECUTED SHALL BE AS UNDER

Time Limit :-

Sr.No.	Period	Description of items to be executed
1	Month.....Month	1. Collection of Materials on site

- | | | |
|---|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | From Month 2 to 4 Month | 2. Erection of Plant Machinery as required |
| 3 | From Month...to...Month | 3. Laying of asphaltting work carpet & Seal coat & Flushing of sand over surface, side with filling with earth as required and directed. |

ANNEXTURE - B TECHNICAL REQUIREMENTS OF DRUM MIX PLANTS

GENERAL:

The drum mix plant should be of reputed make and proven design, sturdy in structure and capable of producing desired quality of mix as per specification for laying bituminous road surface and should have following essential arrangements:

1. Cold aggregate feeder :

The cold aggregate feeder arrangement should have minimum 3 bins of sufficient capacity capable to storing different sizes of aggregates and lines to ensure continuous uninterrupted supply of aggregate matching the capacity of the plant. Each bin should have independent belt feeder system driven by a variable speed motor and a control gate to ensure accurate aggregate feed to meet design mix formula. It is pre-requisite that only properly screened and graded materials are fed to the bins.

There should be a gathering conveyor to receive and transport material discharged from this bins with separate drive arrangement.

There should be a suitable arrangement like baffle plate at the discharge end of gathering conveyor for rejection of any oversize metal above the permissible limit. The conveyor should be fitted with suitable electronic weigh device for weighing quantity of cold aggregate being fed to dryer drum.

The plant should have a mineral filler arrangement with suitable control device to accurately proportion the flow of filler material into dryer drum at appropriate stage.

2. Dryer Drum :

It should be thermo drum type with smooth rotation arrangement to give rated output and capable of reducing the moisture content of the aggregate to desirable limit of 2% to 6% and achieving hot mix temperature (upto 160°C as per requirement) with such design that no blue smoke is emitted from the exhaust. The drum may have optional arrangement for feeding reclaimed material. There should be arrangement to restrict burner flame upto certain length in the drum before bitumen is injected.

It should be fitted with positive displacement bitumen pump driven by variable speed motor automatically controlled from control cabin, capable of feeding desired quantity of bitumen synchronised with aggregate feed system. Thermo mix fluid system or hot oil circulation system should have an in-built feature to keep bitumen pump and pipes sufficiently hot to avoid clogging of pipes.

3. Burner :

The burner used should be capable of burning the fuel efficiently and develop the required temperature. It should be fitted with remote control system, to detect flame failure, and also electric spark ignition system or some other suitable arrangement. Burner operation should have thermostatic control of Flame within the specified temperature range.

4. Bitumen Heater :

It should consist of an insulated tank of adequate capacity fitted with effective and positive control of temperature, for allowing continuous circulation of bitumen between bitumen Heater and proportioning units. Suitable arrangements should be provided for recording the temperature at the tank and in circulating system.

5. Fuel System :

Fuel tanks should be of sufficient capacity and fitted with suitable type of fuel pump to receive the fuel from storage tank supply to line heater and burner.

6. Cyclone System :

Cyclone unit is required to control dust discharge within the admissible standard of pollution level.

7. Operation control unit :

The drum mix plant must have centralised control system with operation from a control cabin located adjacent to the drum mix plant. The control system should be capable of following:

- Automatic control of speed of each bin feeder conveyor and gate so as to control and regulate the flow of various grades of material to ensure constant and accurate proportion of aggregates.
- Pre-set and control the percentage of flow of aggregate and asphalt required as per design mix.
- Automatic detection of plant operation, failure, display of aggregate temperature; asphalt and mix temperature, aggregate flow etc. Fully automatic aggregate blending, bitumen/aggregate ratio control and burner control system.
- Control for pre-setting the moisture content of aggregate display digitally.
- Entire control system should be such that if desired, it would be operated manually also.

8. Surgo Silo :

The plant may have optional arrangement to store hot mix materials for at least equivalent to 30% of rated capacity to cater for any delay in loading the tippers. Temporary storage silo should have adequate automatic hydraulic unloading arrangement operated either from the control cabin or manually with necessary safety control.

STANDARD TECHNICAL SPECIFICATIONS FOR ROAD WORKS

Item No. 1 : Clearing and grubbing road length including uprooting rank, vegetation grass, bushes, shrubs, seedlings and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials By mechanical means in area of light jungle (A) By Manual means in area of light Jungle, (B) By Manual means in area of thorny Jungle, (C) By Mechanical means in area of light Jungle & (D) By Mechanical means in area of thorny Jungle

201. CLEARING AND GRUBBING

201.1. 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 in advance of earthwork operations and in accordance with the requirements of these specifications.

201.2. 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 as stipulated in Clause 306.3.

201.3. 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/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. 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 metres, shall be suitably treated.

201.4. 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 stumps, boulders, stones etc., shall be done at specified spots with all lifts and up to a lead of 1000 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.

201.5. Measurements for Payment : Clearing and 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.

Cutting, including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction shall be measured in terms of number according to the sizes given below :

- | | |
|----------------------------|------------------------------|
| i) Above 300 mm to 600 mm | iii) Above 900 mm to 1800 mm |
| ii) Above 600 mm to 900 mm | iv) Above 1800 mm |

For this purpose, the girth shall be measured at a height of 1 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

201.6. Rates

206.6.1 The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the

Note : MOST / MORT & H specification No. means Relevant specification in fourth edition of Ministry of Road & Transport & Highways Specification Booklet.

required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary and handling, salvaging, piling and disposing of the cleared materials with all lifts and upto a lead of 1000 m.

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

201.6.3. Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earth work items and the Contract unit prices for the same shall be considered including clearing and grubbing operations.

Item No. 2(A) : Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work (B) Rubble masonry / Brick masonry

1. This work shall consist of removing, as here in after set forth, existing culverts, bridges, pavements, kerbs and other structures like guard-rails, fences, utility poles, manholes, catch basins, inlets, etc. Which are in place but interfere with the new construction or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.

2. Existing culverts, bridges, pavements and other structures which are within the highway and which are designed to be removed shall be removed upto the limits and extent specified in the drawings or as indicated by the Engineer-in-charge.

3. Dismantling and removal operations shall be carried out with equipment and in such a manner as to leave undisturbed, adjacent pavement, structure and any other work to be left in place.

4. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

5. The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.

6. Unless otherwise specified, the superstructure portion of culverts/ bridges shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent materials if required in connection with the dismantling of the structures, shall be incidental to this item.

7. Where existing culverts/ bridges are to be extended or otherwise incorporated in the new work, only such part of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work as dowels or ties shall not be injured during removal of concrete.

8. Pipe culverts shall be carefully removed in such a manner to avoid damage to the pipes.

9. Steel structures shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawing or directed by the Engineer-in-charge that structure is to be removed in a condition suitable for re-erection, all members shall be match marked by the contractor with white lead paint before dismantling end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location, all pins, pin holes and machined surface shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjoined members or packed in boxes.

10. Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber as is designated to be salvaged by the Engineer-in-charge.

11. In removing pavements, kerbs, gutters and other structures like guard rails, fences, manholes, catch basins, inlets, etc. where portions of the existing construction are to be left in the finished work the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing strata. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer-in-charge.

12. All concrete pavements, base course in carriage way and shoulders etc. designed for removal shall be broken to pieces whose volume shall not exceed 0.02 cubic metre and stockpiled at designated locations if the materials is to be used later or otherwise arranged for disposal as directed.

13. Where directed by the Engineer-in-charge holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials thoroughly compacted in line with surrounding area.

14. All materials obtained by dismantling shall be the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like material with the right of way as directed by the Engineer-in-charge, for which Contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged materials. Pipe culverts that are removed shall be cleared and neatly piled on the right-of-way at point designed by the Engineer-in-charge.

15. Pipe culverts that are removed shall be cleared and neatly piled on the right of way at points designated by the Engineer-in-charge.

16. Structural steel removal from old structure shall, unless otherwise specified or directed, be stored in a neat and presentable manner. Structures or portions thereof which are specified in the contract for re-erections shall be stored in separate piles.

17. Timber or lumber from old structure which is designated by the Engineer-in-charge as materials to be shall have all nails and bolts removed there from and shall be stored in neat piles locations suitable for loading.

18. All the products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or auctioned shall, be disposed as directed, within 100 metres.

19. The work of dismantling structures shall be paid for in units indicated below by taking measurements before and after, as applicable.

(i)	Dismantling Stone/brick/concrete (Plain and Reinforced) masonry	Cubic Metre
(ii)	Dismantling flexible and cement concrete pavement./RCC pipes	Cubic Metre
(iii)	Dismantling steel structure.	Tonne
(iv)	Dismantling timber structure	Cubic Metre
(v)	Dismantling pipes, guard rails, kerbs, gutters and fencing.	Linear Metre
(vi)	Utility poles.	Nos.

20. The contract unit rates for the various items of dismantling shall be payment in full for carrying out the required operations including full compensation for all labour materials, tools, equipment, safeguards and incidentals necessary to complete the work. These will also include excavation and backfilling where necessary and for handling, salvaging, piling and disposing of the dismantled materials within all lifts and upto a lead of 100 metres.

Item No. 2(B) : Rubble masonry / Brick masonry :-

The relevant specifications of Item No. 2(A) shall be followed except that specification shall be executed for Rubble masonry / Brick masonry instead of R.C.C. work.

Item No. 2(C) : Demolition & disposal of unserviceable materials with all lead & lift. (ii) unreinforced cement concrete.

1.0. Workmanship

1.1. The demolition shall consist of demolition of one or more parts of the building as specified or shown in the drawings. Demolition implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown in the drawings.

1.2. The demolition shall always be planned before hand shall be done in reverse order to the one in which the structure was constructed. This scheme shall be got approved from the Engineer-in-charge before starting the work. This however will not absolve the contractor from the responsibility of proper and safe demolition.

1.3. Necessary propping, shoring and under pinning shall be provided for the safety of the adjoining work or property, which is to be left intact, before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining property.

1.4. Wherever required, temporary enclosures or partitions shall also be provided. Necessary precautions shall be taken to keep the dust nuisance down as and where necessary.

1.5. Dismantling shall be commenced in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roof, masonry etc. shall be carefully dismantled first. The dismantled articles shall be properly stacked as directed.

1.6. All materials obtained from demolition shall be the property of Government unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.

1.7. Any serviceable materials, obtained during dismantling or demolition shall be separated out and stacked properly as directed with all lead and lift. All unserviceable materials, rubbish etc. shall be stacked as directed by the Engineer-in-charge.

1.8. On completion of work, the site shall be cleared of all debris rubbish and cleaned as directed.

2.0. Mode of measurements and payment

2.1. Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed. The demolition of lime concrete shall be measured under this item. Specification for deduction for voids, openings etc. shall be on same basis as that employed for construction of work.

2.2. All work shall be measured in decimal system as fixed in its place subject to the following limits; unless otherwise stated hereinafter : (a) Dimensions shall be measured to the nearest 0.01 mt. (b) Area shall be worked out to the nearest 0.01 sq. mt. (c) Cubical contents shall be worked out to the nearest 0.01 Cu.m.

2.3. The rate shall include cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable materials properly and disposing the unserviceable materials with all lead and lift. The rate also includes for temporary shoring for the safety of the portion not required to be pulled down or of adjoining property and providing temporary enclosures or portions where considered necessary.

2.4. The rate shall be for a unit of one cubic meter.

ITEM 3-A : Earthwork for embankment including breaking clods, dressing with all lead and lift (excluding watering and consolidation) (a) From borrow pits within land width.

1. The land width on which the earth work is to be done shall be cleared of all tree having a girth of 30 cm and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown

on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc. required for setting out, establishing, Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.

3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment of the embankment. The 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 type of hauling equipment.

4. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road side borrow pits on either side with all lead and all lifts.

5. Location, shape and size of borrowpits shall be as indicated by the Engineer-in-charge. Pits shall not be dug continuously. Ridges of not less than 8 metres width should be left at interval not exceeding 300 metres. Small drain shall be cut through the ridges of facilitate drainage. The outer edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 metres. Also no pits shall be dug within 5 metres of the toe of the final section of the road embankment.

5.1 No borrow pits shall be allowed at the following sites along the road.

(i) up to 30 metres on either side of C.D. Works.

(ii) up to 15 metres on either side of cart track crossing for which approaches are to be constructed.

5.2 If there is top layer of black cotton or other objectional soils, the same shall be removed and disposed off elsewhere and usable material found at lower level will only be used in the embankment.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, work as otherwise directed by the Engineer-in-charge. The consolidation including watering and rolling of earth work shall be carried out by the Department. The operations of Laying the successive layer of earth shall have to be suitably. All clods of hard lumps if earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new subgrade level the pavement shall be broken up in pieces not to exceed 0.1 m. and may be left under the new embankment. If the existing road surface is of granulate or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments 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 interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridges and other structures up to a distance of twice the height of the embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given for 14 days, the embankment 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-in-charge. 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 the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify levelling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. If the compaction as stipulated in para above is not done by the department it that

case shrinkage from such earth work quantity shall be deducted as per norms i.e. 10 percent after monsoon and 15% before monsoon. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any, that might have taken place at the time of taking the final measurements of this item.

11. The rate of earthwork includes, clearing jungles, dogbelling, fixing profiles, erecting necessary pillars for stones for bench marks for levelling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in the particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

12. Measurement shall be taken & Paid in Cu.m.

ITEM 3B Earthwork for embankment for side shoulders including breaking clods, dressing with all lead and lift (excluding watering and consolidation) (b) From borrowpits within ____ kms. lead.

Para 1 to 3 of relevant item 3A shall apply.

4. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and all lifts and within land width in the manner specified in para 11 below. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed (if not existing) and maintained by the contractor at his own cost.

5. Department will extend all necessary co-operation in helping contractor to get borrow area from nearby Government or Panchayat land, if available. However, department is not responsible if not such area is made available to the contractor and in the case, contractor will have to make his own arrangement to get borrow area for borrowing earth of the quantity even by making temporary arrangement with the private land owners.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new subgrade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50mm so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments 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 interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment 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-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment 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-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross sections, longitudinal section etc., in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling

* Fill in the blank whichever is applicable from 0.5 Km / 1 Km / 2 Km / 3 Km, while making the D.T.P.

work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. Deduction of 15% for shrinkage shall be made from gross measured quantity if measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any, that might have taken place at the time of taking final measurement of the item.

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions -

- (i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter.
- (ii) The width of the drain shall be restricted to 1.5mts. only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.
- (iii) If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. Not pit, other than this drain, shall be dug within 5 meters of the toe to the final section of the road embankment.
- (v) No borrow pits shall be allowed in the length in which earth obtained from cutting from cutting is specified to be used in embankment.

12. The rate of earthwork includes, clearing jungles, dogbelling, fixing profiles, erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in the particular item. No payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

13. Measurement shall be taken & Paid in Cu.m.

ITEM - 4 : Earth Work In cutting In all sorts of Soil and Soft Murrum including conveying and putting the stuff spoil bank maintaining minimum distance of five meter between top edge of cutting and top of bank. (a) within 200 metres from the ends of the cutting with all required Lead and Lift. (B) for spoil bank.

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

2. After clearing the site, the alignment of the road shall be properly set out true to lines, curves slopes, grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones mortar, concrete etc. required for setting out alignment establishing bench marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms, profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. 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 has started, no cognizance of any complaint shall be taken. Merely not signing of the book shall not be deemed as disagreement.

3. Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10m. to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections, grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for that lift shall be excavated in steps. These steps shall be smoothened to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevant item. The Engineer may require measurement ridges and dead man to be left at specified intervals or places and kept intact till ordered to be removed for the purpose of check measurements. The excavation shall be finished neatly, smoothly, and evenly to the correct lines, curves, grades, if loose shall be scarified, watered and compacted to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be drained by providing for necessary diversions etc, and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his

own cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The contractor at his own cost shall make 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 sections and shall be measured along with the main cutting in cubic meters.

4. If slides occur in the cutting they shall be removed as ordered by the Engineer. If finished slopes slide into the roadways before the final acceptance of the work, such slides shall be removed by the contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the contractor. The classification of the material in slides shall conform to its conditions at the time of removal and payment made accordingly regardless of its prior condition. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials, boulders and collapsing sides etc.

5. If there is traffic nearby or if there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7mt. from the danger point on both sides giving sufficient warning. If necessary, signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc., due to the negligence of the contractor, he will be responsible and liable to all the consequences including compensation.

6. All the excavated materials shall be property of Government. When the useful excavated material is to be used in embankment within a lead of 200 metre and all lift, it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places, without interfering with the drainage in any way. If no Government 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 not required for use on embankment or unsuitable materials may be used on his own to uniformly widen embankment to flatten slopes and to fill low places in the road land, if so permitted by the Engineer. 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. The excavated material shall not be deposited within 3 m. from the top edge of slope or toe of the bank. The lead shall be measured from the junction point of cutting and embankment up to 200 mt. on either side.

7. If the contractor does not wish to utilise the quantity of cutting within the specified lead for any reason, then he may do the embankment work with the earth from other sources (except borrow pits in the length of the road where cutting stuff is to be utilised) but in that case the full or part quantity on acceptable quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at, within the chainage measured as above.

8. Contract rate shall be a unit of one cubic metre for the start mentioned in the wording of the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. Excavation shall be measured in its original positions by taking cross sections before the work starts and after it is entirely completed. The quality shall be worked by the average end area method. When the classification of the strata changes, the contractor shall bring this to notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

(b) In Spoil Bank : Specification shall be as per Item 2(a) except that the excavated stuff shall be deposited in spoil Bank instead of using same in road embankment.

Item No. 5 :- Earth work for embankment including breaking clods, dressing with all lead and lift and including watering, rolling and consolidation of sub-grade in layers at O.M.C to required dry density including filling the depressions which occur during the process using Power / Vibratory roller (A) to (E) land width / 0.5 Km. / 1.0 Km. / 2.0 Km. / 3.0* Km. From borrow area within _____ lead.

305. EMBANKMENT CONSTRUCTION

General :

Description: These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained 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.

305.1 Materials and General Requirements.

305.2.1 Physical requirements :

305.2.1.1. The materials used in embankments, sub grades, earthen shoulders and miscellaneous backfills shall be soil, murrum, gravel, a mixture of these or any other material 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 sub grade.

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; and 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;

* Strike out which one are not applicable.

(e) Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and

(f) Materials with salts resulting in leaching in the embankment.

305.2.1.2 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 with acceptable "free swelling index" value is used as a fill material, sub grade and top 500mm portion of the embankment just below sub grade shall be non-expansive in nature.

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per liter when tested in accordance with BS:1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementations materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO₃) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm or other distances described in the contract, of metallic items forming part of the Permanent Works.

305.2.1.4 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm when being 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 shall not be more than two-thirds of the compacted layer thickness.

305.2.1.5 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 SUBGRADE MATERIALS.

S.No.	Type of work	Maximum laboratory dry unit weight when tested as per IS:2720(Part 8)
1.	Embankments upto 3 metres height, not subjected to extensive flooding.	Not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 metres height or embankments of any height subject to long periods of inundation.	Not less than 16.0 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 materials e.g. cinder, flyash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

(3) The materials to be used in sub grade should also satisfy design CBR at the dry unit weight Applicable as per Table 300-2.

305.2.2 General Requirements :

305.2.2.1 The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

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

305.2.2.2 Borrow materials: Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of materials for embankment and sub grade as well as compliance to 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 300m. Small drains shall be cut through the ridges to facilitate drainage.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising therefrom.

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 sitting of temporary buildings or structures.

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 sub grade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the sub grade.

TABLE 300-2. COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE.

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 Part 8
1. Sub grade and earthen shoulders	Not less than 97

2.	Embankment	Not less than 95
3.	Expansive Clays	
a)	Sub grade and 500mm. portion just below the sub grade.	Not allowed.
b)	Remaining portion of embankment	Not less than 90

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

- The values of maximum dry density and optimum content obtained in accordance with IS:2720(Part 7) or (Part 8) as the case may be, appropriate for each of the fill materials he intends to use.
- A graph of 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 Dry density-moisture content-CBR relationships for light, intermediate and heavy comp active efforts (light corresponding to IS:2720 (Part 7), heavy corresponding to IS:2720(Part 8)

And intermediate in-between the two) for each of the fill materials he intends to use in the Sub grade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

305.3 Construction Operations :

305.3.1. Setting Out : 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 be desired density and the position specified and conforms to the specified side slopes.

305.3.2 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 the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.5 shall apply.

305.3.3 Stripping and Storing topsoil : In localities where most of the available embankment materials are not conducive to plant growth, or 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.

305.3.4 Compacting ground supporting embankment/Sub grade:

Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling 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 per cent relative compaction with respect to the dry density as given in Table 300-2, the ground shall be loosened up to a level 0.5m below the sub grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to not less than 97 per cent of dry density as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or sub grade work shall not proceed until the foundations for embankment/sub grade have been inspected by the Engineer for satisfactory condition and approved.

305.3.5 Spreading material in layers and bringing to appropriate moisture content :

The embankment and sub grade material shall be spread in layers of uniform thickness not exceeding 200mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 305.3.6. 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.

305.3.5.2 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 baling, dicing or barrowing 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.

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.

All permanent faces of side slopes of embankments and other areas of fill formed 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.

305.3.6. Compaction : Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Power or Vibratory rollers 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 power roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

When density measurements reveal any soft areas in the embankments / subgrade / 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 to the density requirements and satisfaction of the Engineer.

305.3.7 Drainage : The surface of the embankment/subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

305.3.8 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.

305.3.9 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.

305.4 Construction of Embankment and subgrade under special conditions.

305.4.1 Earthwork for widening existing road embankment :

When an existing embankment and/or subgrade 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/subgrade 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 small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer.

305.4.2 Earthwork for embankment and subgrade 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/subgrade material.

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 subgrade work as approved by the Engineer.

305.4.3 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 or bituminous type and lies within 1 m of the new subgrade level, the same shall be scarified to a depth of 50mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

(ii) If the existing road surface is of cement concrete type and lies within 1 m of the new subgrade level the same 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 permitted to stay in place without any modification.

305.4.4 Embankment and subgrade 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 subgrade 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 Appendix 6 of IRC: 78.

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 2502/309.3.2 (B) 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.

305.4.5 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.

305.4.6 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 consist of graded, hard durable particles with maximum particle size not exceeding 75mm. 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.

305.4.7 Earthwork for high embankment :-

In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

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 in any surcharging

Material, which is unacceptable for use in the fill being surcharged, lying below formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bring the resultant level upto formation level with acceptable materials.

305.4.8 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.

305.5 Plying of Traffic :

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or subgrade 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 expense as directed by the Engineer.

305.6 Surface Finish and Quality Control of Work :-

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

305.7 Subgrade Strength :-

It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.

Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mould fitted with cutting shoe or on remoulded samples, compacted to the field density at the field moisture content.

305.8 Measurements for Payment :-

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas.

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.

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

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

Stripping including storing and reapplication of topsoil shall be measured in cu.m.

Work involving loosening and recompacting of ground supporting embankment/subgrade shall be measured in cu.m.

Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in Cu.m.

Scarifying existing granular/bituminous road surface shall be measured in Square metres.

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

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

305.9 RATES :

The Contract unit rates for the items of embankment and subgrade 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 other wise in the contract.
- (ii) Setting out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;
- (iv) Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade;
- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contract.
- (xi) All labour, material, 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.

In case the Contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the contract for construction of embankment and subgrade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

Measurement shall be taken and paid in Cu.m.

Item No. 6(A) :- Rolling & watering of earthwork in layers with Power including filling in depressions which occur during the process. Layer not exceeding ____ mm.

1. For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm 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 here under :-

Moisture content of materials shall be checked at the source of supply and if found less than that specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hose line or from a truck mounted water tank, and flooding shall not be permitted under any circumstances.

If the materials delivered to the road bed is wet it shall be dried, by evaporation and exposure to the sun, till the moisture content is brought down to acceptable standard for compaction. Should circumstances arise, Where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IST 2720 (Part-II) and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with ISI (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet. Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5 meter portion of the embankment.

below the subgrade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction. Where the embankment is to be constructed on low area ground that will not support the weight of trucks of other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

2. COMPACTION :

Only compacting equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intends to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2 Table.

1.2 Compaction requirements for embankment.

Sr. No.	Type of Work/materials	Field dry density as percentage of maximum laboratory dry density as per IS:2720 (Part-VII)
1.	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100.
2.	Other portion of embankment.	Not less than 95
3.	Highly expensive class	85 to 90

Subsequent layers shall be placed only after finished layer has been tested according to M.O.S.T. specification clause 902 and accepted by the Engineer-in-charge.

When density measurements reveal any soft areas in the embankment further compaction shall be carried out as directed by the Engineer-in-charge. If inspite of that the specified compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement to the satisfaction of the Engineer-in-charge.

3. Measurements for Payment :

Consolidation of earth embankment construction shall be measured by taking cross section at intervals in the original position before the work starts and after its completion and computing of the volume of earthwork in cubic meters by the method of average and areas. The measurement of fill material from borrow area shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation. For this purpose it shall be assumed that one cubic meter of suitable materials brought to site from roadway and drainage excavation from one cubic meter of compacted fill and all bulking or shrinkage shall be ignored. Stripping including storing and reapplication of top soil shall be measured as volume in cubic meter.

4. The contract unit rate includes cost of mechanical roller required for consolidation including all labour, equipments fuel, hire charges, tolls, and incidentals necessary.

Item No. 6(B) :- Rolling & watering of earthwork in layers with vibratory roller 80 kN to 100 kN static weight including filling in depressions which occur during the process. Layer not exceeding ___ mm.

Relevant specification of Item No. 5(A) shall be followed except that, vibratory roller 80 kN to 100 kN static weight shall be used instead of Power roller.

ITEM-7 : Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed up to 200 mt. from the end of cutting with all lead and lift (i) Hard Murrum.

(1) Para 1 to 8 of Item "Earth work in cutting in all sort of soil" shall apply except that the work shall be carried out in hard murrum.

(9) Earth work in cutting shall be made in hard soil such as stiff heavy clay, hard shale or compact murrum, requiring grating tool or pick or both and shovel, closely applied and gravel and rubble stone having maximum diameter direction between 75 and 300 mm and soft conglomerate. The classification of cutting shall be decided by the Engineer-in-charge and his decision shall be binding on the contractor. Mode of measurement shall be measured after removal of over burden by taking cross section at suitable intervals in the original position before the work starts and after its completion areas. Payment shall be made in CMT basis. The rate shall include the cost of labour tools to complete the job.

ITEM-8 : Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed up to 200 mt. from the end of cutting with all lead and lift (i) Soft Rock (not requiring blasting)

(1) Para 1 to 8 of Item "Earth work in cutting in all sort of soil" shall apply except that the work shall be carried out in soft rock.

(9) Earth work in cutting shall be in soft rock such as lime stone, sand stone, laterite, hard conglomerate or other soft rock which may be quarried or split with crow bars, boulders which do not require blasting and any rock which dry state may be hard, requiring blasting but which when wet becomes soft and manageable by means other than blasting. The classification shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

(10) Mode of measurement shall be measured after removal of over burden by taking cross sections at suitable intervals in the original position the work starts and after its completion and computing the volumes in cubic meter by method of average and areas, payment shall be made on CMT basis. The rate shall include the cost of labour, tools to complete the job, Name of the works :

Item No. 9 :- Box cutting the road surface to proper slope and camber for making a base of road work including removing the excavated stuff depositing on the road side slope as directed up to 50 mt. lead.

The sub grade / sub base / base to receive the water bound macadam course shall be prepared to the specified grade and camber and made of dust and other extraneous materials. Any nets of soft places shall be corrected in an approved manner and rolled until firm.

Cutting shall be paid on cross section area as established by the longitudinal level and cross sections for this purpose. The work shall be started after the initial longitudinal section of the ground and cross sections are taken and recorded.

The final surface shall conform to proper profile, camber and super elevation etc. as directed by the Engineer. The earthwork shall be paid on sectional measurements, cross sectional etc. taken.

No allowance or payments shall be made for materials excavated prior to the taking of level by the Engineer.

The rate is inclusive of cutting in all soil and murrum including removal of all shrubs, jungle cutting, cutting stuff in slopes, side drain work etc. complete.

This item also includes the clearing the sides and demarking the line as per requirement and cutting out the existing trees on the road side, not extra payment will be paid for.

At the time of preparing final bill, the road formation in embankment and cutting shall have to be perfect condition true to grade, camber and side slope duly dressed and damages due to rain cuts etc. during entire working period shall have to be done by the contractor.

The work taken in length shall be completed in all respects viz. width, grades, camber, side drains, side slopes etc. and measurements for incomplete work shall not be taken otherwise.

1.0 Mode of Measurement & Payment :

The unit rate box cutting shall include the cost of all materials, tools and plant required for excavation in all type of soils in grade and camber, line and levels and finishing as per direction of the Engineer-in-charge, excavation and all other incidental expenses for producing item of box cutting of specified breadth and depth and grade to complete the item or its components as shown on the drawings and according to these specifications.

The box cutting shall be measured for its cross section area and compacting volumes in cubic metres by the method of average areas.

The rate will be made on Cubic Meter basis of the finished work.

ITEM - 10 Excavation for foundation up to 1.5 m depth including sorting out and stacking of useful material and disposing stuff 50 metre lead. (A) in loose or soft soil (B) in dense or hard soil.

1. Excavation for structures shall consist of the removal of material for the construction of foundations for culverts, retaining walls, cut of walls pipe culverts and other similar structures, in accordance with the requirements of these specifications and the lines and dimensions shown on the drawing or as indicated by the Engineer-in-charge. The work shall include all necessary sheet piling, shoring, bracing, draining, pumping and the removal of all logs, stumps, grubs and other deleterious matter and obstructions necessary for placing the foundations, trimming bottoms of excavations, backfilling and clearing up the site and the disposal of all surplus material.

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves and slopes.

3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of persons and works and to the satisfaction of the Engineer-in-charge.

4. The depth to which the excavation is to be carried out shall be as shown, on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.

5. Where waters is met with in excavation due to stream, flow, seepage springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, constructing diversion channels drainage channels, and other necessary work to keep the foundation trenches dry when so required and to protect green concrete/masonry against damage by erosion or sudden rising of water level. The method to be accepted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering, and protection, arrangements and for the quality and safety of the work.

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

7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose of bringing the foundation to level. If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.

8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution sign and marked with red lights at night to avoid accidents. The contractor shall be required to take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.

9. Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause under thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm loose layers. Which shall be watered and compacted.

10. All the excavated materials shall be the property of the Government. Where the excavated material is directed to be used in the construction of embankment, it shall be directly deposited at the required locations.

11. All useful materials, not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 50 metres lead. Unsuitable and surplus materials not intended for use in any part of the road shall be disposed off as directed by the Engineer-in-charge.

12. Excavation for structures shall be measured in cubic metres for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer-in-charge. Excavation over increased width, cutting of slopes, shoring, shattering and planking shall be deemed as convenience for the Contractor in executing the work and shall not be measured and paid for separately.

13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including:

1. Setting out
2. Construction of necessary shoring and bracing and their subsequent removal;
3. Removal of all logs stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads upto 100 metres;
6. All labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.

14. Excavation shall be for ordinary soil such as vegetable or organic soil, turf slit, and loam, clay, mud, plat, black cotton soil, soft shale or soft murrum a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 11 - DO - in hard murrum

1.0 Para 1 to 13 of the item of excavation for foundation in all sorts of soil shall apply.

14. Excavation shall be in hard soil such as stiff heavy clay, hard shale or compact murrum requiring grafting tool or pick or both and shovel. Closely applied and gravel and rubble stone having maximum diameter in any one direction between 75 and 300 mm and soft conglomerate. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 12 - DO - in soft rock

1. Para 1 to 13 of the item of excavation for foundation in all sorts of soil shall apply.

14. Excavation shall be in soft rock such as limestone, sand stone, laterite, hard conglomerate or other softer disintegrated rock which may be quarried or split with crow bars, boulders which do not require and any rock which in dry state may be hard, requiring blasting but which when wet becomes soft and manageable by means other than blasting. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 13 - DO - in hard rock

1. Para 1 to 13 of the item of excavation for foundation in all sorts of soil shall apply.

14. Excavation shall be in any rock or boulders for which the use of mechanical plant for blasting is required. The classification of excavation shall be decided by the Engineer-in-charge 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-in-charge.

15. In the opinion of the Engineer-in-charge where blasting is prohibited for any reason, excavation shall be carried out by chiselling, wedging or any other agreed method.

16. Blasting shall be carried out with the written permission of the Engineer-in-charge. All the statutory law, regulation rules, etc. pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.

17. The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements, after approval from the Engineer-in-charge.

18. The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approval site. No unauthorised person shall be admitted into the magazine which when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hung in the lobby of magazine.

- (a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.
- (b) A statement of upto date stock in the magazine.
- (c) A certificate showing the last date of testing of the lightning conductor.
- (d) A notice that smoking is strictly prohibited.

19. In addition to these, the Contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer-in-charge and shall be responsible for damage to property and any accident which may occur to workmen or the public on account of any operations connected with the storage, handling or use of explosive and blasting. The Engineer-in-charge shall

frequently check the Contractor's compliance with these precautions.

20. All the materials, tools and equipments used for blasting operations shall be approved type. The Engineer-in-charge may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the fires or reach safely before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder explosives, detonators etc. shall be fresh and not damaged due to damp, moisture or any other cause. They shall be inspected totally and removed immediately.

21. The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the handling explosives and blasting operations.

22. The blasting shall be carried out during fixed hours of the day preferably during the midday lunch hour or at the close of the works as ordered in writing by the Engineer-in-charge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.

23. Red danger flags shall be displayed prominently in all directions during the blasting operations. People except those who actually light the fuse, shall be prohibited from entering this areas. The flags shall be planted 200 meters from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.

24. The enlarge holes shall be drilled to required depths and in suitable places. Blasting should be as light as possible consistent with through breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

25. When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then, be covered with tamping materials which shall be tamped light but firmly.

26. When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire, or twine. The primer shall be housed into the explosive. Bore holes shall be of such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive inserted. The space of about 20 cm. above the charge shall then be gently filled with dry clay, passed home and the rest of the tamping formed of any convenient material gently packed with a wooden hammer.

27. At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charge shall be lighted by the man in charge only. The man in charge shall count the numbers explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

28. In case of a misfire, the following procedure shall be observed.

(1) Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charges.

(2) If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at about 45 cm from the old hole and fired. This should blast the old charge should it not blast the old charge the procedure shall be repeated till the old charge is blasted.

(3) In case of charges of gelatin, dynamite, etc. the man in charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge alternatively the hole may be cleared of 30 cm. of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 15 cm away and parallel of it. This hole shall then be charged and fired. The misfired hole should explode at the same time. The man in charge shall at once report to the contractor's office and Engineer-in-charge all cases of misfire, the cause of the same and what steps were taken in connection therewith.

29. If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority by the Engineer-in-charge for inspection to ascertain whether all the remaining materials in the box are also defective.

30. A careful and day to day account of the explosive shall be maintained by the contractor in the approved register and manner which shall be open to inspection by the Engineer-in-charge at all times.

31. Excavation shall be measured after removal of over burden by taking cross sections at suitable intervals in the original position before the work starts and after its completion, and computing the volumes in cubic meters by the methods of average end areas. 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-in-charge, the Contractor shall leave depth indicators during excavation 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. 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 stacks of excavated rubble after making 40 percent deduction therefrom.

ITEM-13 (B) : Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm. in depth consolidating each deposited layer by ramming and watering.

1.0 The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

2.0 As soon as the work in foundation has been completed and measured, the site of foundation shall be cleared of all debris, stone, motor droppings etc. and filled with earth in layers not exceeding 20 cms. each layer shall be adequately watered, rammed and consolidated before the succeeding layers is laid. The earth shall be rammed with iron rammers where feasible and with the butt ends of crow-bars, where rammer can not be used. With iron rammers finished level, the surface shall be flooded with water for atleast 24 hours and allowed to dry and then rammed and consolidated.

3.0 The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth under no circumstances black cotton soil be used for filling.

4.0 The payment shall be made for filling in trenches and plinth. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

5.0 The rate shall be for a unit of one cubic metre.

ITEM-14 Extra for dewatering in foundation etc. as directed.

1.0 Where water is met within excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, to keep the foundation trenches dry when so required and protect green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the work.

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

3.0 The measurements shall be paid on Cubic Meter basis for each class of materials encountered.

4.0 The rate includes the cost of dewatering including pumping.

ITEM - 15 (A) : Supplying and Stacking murrum binding materials including materials on road side including filling boxes with all lead & lift etc. complete.

1. Material for the purpose shall be of approved quality. Any material which is found inferior shall be rejected and the contractor shall remove such rejected material from the site at his own cost. The material shall be collected from quarries approved by the Executive Engineer. The material shall be granular and gritty.

2. The material shall be got approved by the Executive Engineer prior to collection on site. It shall be free from all rubbish, dust and any organic materials as well as clods of black cotton soils. Materials shall not be allowed to be collected from within the road boundary. Material to be used as crust and for side shoulders shall be as per C.B.R. report and that to be use bindage in W.B.M. road construction shall have P.I. value of less than 6 as determined in accordance with IS 2720 (Part-V). The material to be used should be got tested prior to its use in road construction. Testing charges shall be borne by the contractor.

3. River or nala or sea sand required for the work shall be clear, sound, properly, graded, free from organic materials-silt clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by the Engineer-in-charge. The sand shall be well graded.

The payment shall be made on Cubic Metre basis.

4. Stacking shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from the grade measurements. Where any doubt exists as to whether the quantity of stacks of murrum in an hectometre is not confirming with the cubic content of the standard pharas (2 x 1.5 x 0.5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of murrum in any stack in a particular hectometre is found to be less than the standard measurements viz., 1.5 cmt. the entire collection in the hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking of the murrum shall be done in a manner as directed by the Engineer-in-charge.

5. For road work completed stacking of murrum as per requirement shall be carried out in 2 K.M. length before spreading. The collection shall always, be commenced at one end of the K.M. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.

6. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

7. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.

8. The rate quoted are inclusive of all shall such tools, duties, fees, royalties, taxes etc.

Item-15(B) : Supplying and Stacking hard murrum/ sand/yellow earth/ binding materials on road site including filling boxes with all leads and lifts etc. complete on site of work as per specification.

1. The materials for the purpose shall be of approved quality. Any materials which is found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer or his authorised agent.

Para 3 to 8 of Item No. 15 shall apply.

The sand used as crust shall be as per C.B.R. Report.

9. The measurements shall be taken on cubic metre basis.

ITEM NO 16 : Supplying standard size stone aggregate.

ITEM NO.16(A) Supplying and stacking of hand broken stone coarse aggregates chippings etc of hard stone of size 25mm.to 90 mm size nominal size free of disintegrated pieces, deleterious and organic matter including Filling boxes with all lead and lift etc complete for W.B.M. road.

1. The stone metal shall be obtained from quarries approved by the Executive Engineer prior to collections. The metal shall be of approved quality with all leads and lift. The metal shall be obtained from hard tough, sound durable, stone of close texture as is locally available and reasonably free from decay and weathering. Pieces of the stone shall be angular and roughly cubical in shape and round, elongated or flaky materials shall be allowed. The size of metal shall be 25 mm to 90 mm and shall be hand broken. All unsound weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layers of boulders shall be rejected.

2. The samples of metal collected from approved quarries shall be got tested at Government recognized laboratory as may be directed to the contractor at his own cost. The test results shall conform to the standard requirements laid down for metal to be used for W.B.M. work.

3. The physical requirement for standard size metal shall conform to the test results indicated in the Table below :

Type of Const.	Test	Test Method	Requirement
Base	(a) Los Angeles Abrasion Value	IS 2386 Part IV	50% (Maximum)
	Aggregate Impact value	IS 2386 Part-IV or 40%	(Maximum)
	(b) Flakiness Index	IS 5640	15% (Maximum)
		IS 2386 Part-I	

Frequency of test shall be as per Ministry of Surface Transport Specifications.

4. The grading requirements of the metal to be used for W.B.M. shall be as under :

Sr. No.	Size Range	Sieve designation	Percentage by weight Passing through the sieve
1.	25 mm to 90 mm	100 mm	100
		90 mm	90-100
		50 mm	40-60
		25 mm	0-10
		20 mm	0-5

The size of metal for W.B.M shall be 25 mm to 90 mm. wherein tolerance limit for oversize shall be up to 10% and that for lower size should be up to 10%.

5. Wherever any doubt exists as to whether the above requirements are satisfied, in whole or any part of the collection, metal shall be got screened by the contractor at his own cost, if so ordered by Engineer-in-charge.

6. Stacking shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of metal in any hectometre is not conforming with the cubical content of the standard pharas (2 m x 1.5 m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in any stack in a particular Hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge. Collection of metal shall be completed in two hectometre wise as per the final requirement and measurement shall be recorded two hectometre-wise. Until the quantity of metal as per the final requirement is not collected in any two consecutive HM. and std. boxes are not filled in completely in two hectometres, measurements shall not be recorded and payments shall not be done.

7. For road work complete staking of metal as per requirement shall be carried out in 2 Km. length before spreading. The metal stacks shall be measured and recorded and got cross checked by other Deputy Executive Engineer as per rules before spreading. The collection shall always commence at one end of the Km. and be carried continuously towards the other end unless the Engineer-in-charge shall direct otherwise.

8. The payment shall be on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials shall not measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

9. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses. The rates quoted are inclusive of all such tools, duties, fees, royalties, taxes, etc.

- ITEM 16 (B)** Supplying & stacking of hand broken crushed stone aggregate Chippings etc of hard stone of 40mm to 63mm size nominal size free of disintegrated pieces, deleterious and organic matter including filling boxes with all lead and lift etc. complete for road work.

Para 1 to 9 of item of hand broken metal size 25 mm to 90 mm size will apply except the size of metal mentioned in para 1 and the table of grading requirements. These will be as under

- (3) Para 1 to size will be 40 mm. to 63 mm. instead of 25 mm. to 90 mm. in para 1.

- (4) The grading requirements of the metal to be used for W.B.M shall be as under :-

Sr. No.	Size range	Sieve Designation	Percentage by weight Passing through the sieve
1	2	3	4
1.	40 mm to 63 mm	75 mm	100-100
		63 mm	90-100
		50 mm	60-80
		40 mm	0-15
		25 mm	0-5

The size of metal for W.B.M shall be 40 mm. to 63 mm. wherein tolerance limit for oversize shall be 10 percent and that for lower size should be upto 15 percent and below 25 mm it shall be upto 5 percent.

10. Standard for acceptance at reduced rate and rejection shall be as under :-

- (a) Retained on 63 mm. square mesh sieve :

Not more than 30%

- (b) Retained on 75 mm. square mesh sieve :

Nothing will be retained & 100% metal shall be pass through the sieve. For the over size metal, payment at reduced Rate should be made as under :

- (A) 90% of accepted tender rates for the metal retained between 10% and 20% square mesh sieve of 63 mm. gauge.

- (B) 75% of accepted tender rates for the metal retained more than 20% and upto 30% on square mesh sieve of 63 gauge.

If more than 30% of metal is retained on specified sieve, (i.e. 63 mm. square sieve) the stack shall be rejected. Also if any stone aggregate retained on 75 mm. sieve the stack shall be rejected.

The quality for which reduced rate will be applicable is the quantity retained on the above mentioned square mesh sieve and not the whole quantity.

For example in a stack of 1.5 cum. metal if 18% is retained on square mesh sieve of the prescribed size (i.e. 63 mm) the reduced rate of 90% will be applicable to 0.27 cu.m. only and the balance quantity size shall be paid for the accepted rates for standard size metal.

Before any secured advance for metal is paid to the contractor, the metal shall have to be tested for its quality in the laboratory. Contractors' request for such secured advance will be considered only after test results of metals are received and results are satisfactory.

[As per Government circular No. SSR 1070-1B-191-22-S of 5-3-92]

- ITEM 16 (C)** Supplying and Stacking of machine Crushed Stone aggregate Chipping etc of hard Stone of 20 to 50 mm nominal size free of disintegrated pieces, deleterious and organic matter (for bitumen surface dressing etc.) as per I.R.C. Code including filling the boxes with all lead and lift etc. complete.

1. The field of M.C. metal shall be of approved quarry as shown on the quarry chart as well as approved by the Executive Engineer prior to collection.

2. The M.C. metal shall be hard, tough, sound, durable, black trap field metal of close texture, free from decay and weathering. Each piece of the stone shall be angular and roughly cubical in shape and round elongated or flaky material shall be rejected. No round or oblong pebbles or angular chips larger or smaller than specified size shall be allowed.

3. All unsound, weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layer of boulders shall be rejected. The physical requirement for standard size metal shall conform to the test results indicated in para 3 of item 4.

4. The M.C. metal shall be as nearly uniform in size as possible and shall conform to following minimum requirements of passing through the rings :

Sieve Size	Percentage passing through
63 mm	100
50 mm	95-100
40 mm	35-70
20 mm	0-10

5. Wherever and doubt exists as to whether the above requirement are satisfied in whole or part, the collection of M.C. metal shall be got screened by the contractor if so ordered by the Executive Engineer and for which no extra payments shall be claimed by the contractor.

6. Any collection which does not fully satisfy the above requirements is liable to be rejected altogether.
7. Stacking shall be done by filling in the standard steel pharas of 2.00 x 1.50 x 0.50 metre and no deduction of voids shall be made from the gross measurements.
8. Regular stacks shall be done by the contractors on a fairly level ground. All the stacks shall be marked by white wash immediate on being measured and recorded by the Engineer-in-charge.
9. The rate includes blasting the rock, if any, breaking the metal, stacking, measuring in pharas etc. complete.

ITEM - 16 (d) Supplying & stacking machine crushed stone aggregate chipping etc. of hard stone of 25 mm to 40 mm nominal size free of disintegrated pieces, deleterious and organic matter including filling the boxes with all lead and lift etc. complete on site of the work for bituminous surface dressing etc. as per I.R.C. Code.

as per item No. 4 (c) except that gradation of Aggregate shall be as under.

Sieve Size	% by weight passing through
50 mm	95-100
40 mm	65-90
20 mm	0-10
10 mm	0-5

ITEM-16(e) : Supplying and stacking of quarry spauls materials at site including filling boxes with all lead and lift.

1. The quarry spauls shall be approved quarry as approved by the Ex.Engineer prior to collection. Filling of boxes, shall not be allowed till the metal is broken to the specified size.
2. The quarry spaul shall be as uniform in size as possible. The quarry spaul shall be hard, tough, solid, durable of black trap quarry of close texture, free from decay and weathering. The stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No sound or long rubble or angular chips smaller than specified size shall be allowed.
3. All unsound, weathered or disintegrated stone obtained from the under surface layer of the quarry or other layers of boulders shall be rejected.
4. Wherever any doubt as to whether above requirement are satisfied in whole or part of the collection it shall be got screened by the Contractor if so ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor.
5. Any collection which does not fully satisfy the above requirements is liable to be rejected all together.
6. Stacking shall be made by the Contractor by steel pharas of 2 M x 1.5 M x 0.5 M and no deduction of voids shall be made from the gross measurements.
7. Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer-in-charge.
8. The rate includes blasting the rock, if any, breaking the quarry spauls, stacking measuring in pharas etc. complete.
9. Stacks shall as per actual requirements and any materials in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.
10. While stacking materials the depositing should commence at one end of the K.M. and carried continuously towards the other end unless the Executive Engineer shall direct otherwise and as a rule measurements shall be taken after metal for half kilometer or Km. has been fully collected. Any fraction of these distance shall not be measured up.
11. The measurements shall be recorded in on Cum. basis & shall be paid accordingly.

ITEM-16(f) Supplying and stacking rubble of hard stone on road side with all leads and lift as directed.

1. The rubble stones shall be black in colour, shall be hard, tough, sound durable and of close texture, free from cracks and it shall be obtained from the approved quarries.
2. The rubble obtained from the top surface of the quarry is soft one and hence such soft variety shall not be accepted. All unsound, weathered or disintegrated stones obtained from the upper portion of the quarry shall be rejected.
3. The quarry shall be well protected shall be dug by removing all the katcha and weathered stuff till approved quality of materials is available.
4. The length and breadth shall not exceed 1/3 (1.2) times the thickness of the stones.
5. The rubble stacks shall be made on a fairly level ground and stacks shall be so made that rubble stones are stacked as close as possible so as to leave no excessive voids and no hollows are left out.
6. The tendency to prepare the stacks by keeping excessive voids or keeping hollow places shall not be tolerated.
7. The stacks shall be uniform in length and breadth and top portion shall be in level so that height at any point is uniform.
8. All the stacks shall be of standard dimensions which shall be prescribed by the Executive Engineer deduction for voids shall not be made.
9. The rubble shall be got approved by the Executive Engineer, prior to collector on site or otherwise it is liable to rejection for which no claim shall be entertained.
10. The contractor shall maintain all stacks in regular and proper sizes till the whole material is collected. Measured and finally accepted

by the department, 15 percent spalls will be allowed for filling in interstices.

11. The rubble shall be stacked in quantities as per hectometre wise requirement as directed by the Executive Engineer or his agent.

12. Measurement shall be given only when the full quantity of a half kilometer is stacked measurements shall be recorded and paid only once in a hectometre and no piecemeal measurements shall be recorded and paid.

13. Stacks shall be made as per actual requirements and any material in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.

ITEM-16 (G) : Supplying and stacking of rubble including rubble dumping as and where required as directed.

1.0 Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourth of the thickness of wall nor less than 15 cm. The rubble shall be stacked in chhattas manner on fairly levelled ground as and where directed as per the instruction of the Engineer-in-charge. 10% for voids shall be deducted from gross measured quantity. The rate includes all labours, materials, tools and equipments, dumping the rubble and all other incidental expenses occurred. The payment shall be made on cmt. basis.

ITEM-16 (H) : Supplying and stacking unscreened gravel on site of work etc. as directed.

The unscreened gravel shall be obtained from quarries approved by Executive Engineer prior to collection. The material shall be of approved quality with all lead and lift. The material shall be clear and free from organic material, silt, clay etc. and shall be got approved from Engineer-in-charge.

Wherever any doubt exists as to whether the above requirements are satisfied in work or any part of the collection, it shall be rectified by the contractor at his own cost, if so ordered by Engineer-in-charge.

Stacking shall be done by filling in the standard steel boxes of 2 mt. x 1.5 mt. x 0.5 mt. size which shall be supplied by the department if available on rent otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of material in any hectometer is not confirming with the cubical content of the standard pharas (2 mt. x 1.5 mt. x 0.5 mt.) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of material in any stack in a particular Hectometers is found to be less than the standard measurements viz. 1.5 cmt. the entire collection in the Hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on fairly level ground. Stacking of material shall done in a manner as directed by the Engineer-in-charge.

For road work complete stacking of material as per requirements shall be carried out in 2 k.m. length before spreading. The material stacks shall be measured and recorded and got cross checked by the other Deputy Executive Engineer as per rules before spreading. The collection shall always commence at one end of the k.m. and be carried out continuously towards the other end unless the Engineer-in-charge direct otherwise.

The payment shall be made on cubic metre basis without deduction for voids/ The contractor shall maintain all stacks in regular and proper size till the whole materials shall not measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipments and other incidental expenses. The rates quoted are inclusive of all such tools, duties, fees, royalties, taxes etc.

ITEM-17 : Carting and stacking of scarcity hand broken metal on site with all lead including filling the boxes.

The stone metal shall be obtained from stacking of security metal which is broken in previously scarcity period carting shall be done as per instruction of Engineer-in-charge.

Stacking shall be done by filling the standard steel boxes of 2m x 1.5 m x 0.5 m size which shall be supplied by the Department, if available, on rent otherwise contractor shall make his own arrangement and no deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of metal in any hectometer is not confirming with the cubical content of the standard para (2m x 1.5m x 0.5 m) shall be got corrected by the contractor, if so order by the Engineer-in-charge, for which extra payment shall be claimed by the contractor. If the quantity of metal in any stack in particular Hectometer is found to be less than the standard measurement viz 1.5 cm, the entire collection the Hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge. The standard size box measurement for aggregate will be recorded as final and no subsequent charge will be permitted.

The payment shall be made on cubic meter basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The rate includes conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.

ITEM -18 : Spreading Soft murrum/murrum/sand/yellow/earth/bindage or road crust filling the gaps in metal and leveling to camber and gradient as directed.

Spreading of material shall be started after the full supply in a particular K.M. is collected, measured and recorded in the measurement books. Permission of the Engineer-in-charge shall be obtained before spreading. It shall be seen that the formation is dressed to the required camber and grade. If the murrum is to be spread over the metalled surface then the spreading shall be uniform and as its to act as binding surface, it shall be used for filling the interstices of metal and forming a smooth running surface as far as possible. Murrum bindage shall be specified as blindage shall be spread evenly with a twisting motion of the baskets. No more Murrum shall be used then specified as blindage. The rate is for gross measurements and no deduction of voids shall be made. If the murrum is to be spread over earthen embankment as a sub-base or for side shoulders or as blindage, it shall be spread in a manner as directed by the Engineer-in-

charge and as per required width and thickness. The contractor shall make good all unevenness, depression, projections etc., during consolidation work. Rate of this item includes all these operation except consolidation. The payment shall be made on cmt. basis.

ITEM - 19 (A) : Spreading the stone aggregates for soiling and W.B.M. including filling the interstices to required camber and gradient (excluding spreading of blindage) (i) 40 mm to 63 mm size H.B. Stone aggregates (H.B.) (ii) 21 mm to 90 mm size H.B. stone aggregate. (iii) Chipping varying from 6 mm to 25 mm size (iv) 20 mm to 50mm size crushed.

1. Metal shall not be spread without permission of the Engineer-in-charge. Metal should be spread under careful supervision by trained coolies. Contractor shall see that uniform spreading as per collection of metal is done. The contractor shall spread the metal fully from the stacks without keeping any balance unless directed by the Engineer-in-charge to keep some stock in balance for making good unevenness or depressions during rolling works. To ensure that the material is spread to the required thickness, the road surface shall be marked out in to length over which the contents of heaps are to be spread. The bounds of earth or murrum (one on either side) shall be laid with a distance between them equal to the width of road to be metaled and shall be enough to prevent the loose metal from spreading during consolidation as well as to retain water used for consolidation. Payment for bunds will be made in the respective item.

2. The metal (including old metal) shall be screened and rubbish, dust, grass shall be removed and spread evenly on the prepared surface in grade and camber by using camber board etc. so as to ensure that the surface is true to camber and grade. At least two camber by using camber boards shall be in use at site. The surface shall be checked at every 50 ft. by means of template while the correctness of the camber in between shall be tested by string and corrected as required. Between the straight lengths and the curves in camber of road to superelevation shall be made very gradually as may be directed by the Engineer-in-charge.

3. The spreading of metal shall proceed only 200 mt. (max.) advance of the rolling operations. The collection and spreading of the metal shall not be carried out in one and the same kilometer.

4. At the time of rolling all surface irregularities, hollows, depressions, humps etc. shall be straight. The spreading of metal in required layer shall be done by the contractor. The rate for this item shall be paid on cmt. basis and includes all the above operation with all lead and lift except consolidation.

Item-19 (B) : Spreading the stone aggregates for soiling and W.B.M. including filling the interstices forming the surface to required camber and gradient by paver finisher (Labour charges only but including hire and operating charges of paver)

Specification same as item No.19(A) except that metal or stone aggregate shall be spread by paver finisher and not manually. Besides all the labour charges, the rate also includes the hire and operating charges of paver. The contractor shall have to make his own arrangement for procuring appropriate paver.

Item-19 - (C) : Spreading quarry spauls in grade & camber complete.

1. The quarry spauls shall only be allowed to be spread after the written permission of the Executive Engineer is obtained.

2. The permission for spreading the metal shall be given by the Executive Engineer if

- (i) The full quantity of a particular mile (kilometer) is completely collected.
- (ii) The collection of metal is also completed in the adjoining two miles (Kilometers)
- (iii) The measurements are recorded in the Measurement book.

3. Q.S. shall if required, be screened, if containing rubbish dust, grass etc. it shall then be filled in basket & conveyed where required and spread evenly on the prepared surface by given twisting motion to the basket at the time of spreading. The surface shall then (15 m) by means of templates and strings as well as with camber boards and spirit level.

4. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.

5. At the time of spreading Q.S. a small quantity (about 4 to 5 percent) of metal as directed, shall be retained at the first instance. It shall be spread later on after partial consolidated as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid for this.

6. Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on cubic metre basis.

7. The rate includes the cost of screening the Q.S. if any spreading, sectioning, with template and adding reserved quota of metal, while rolling is in progress for making good hollows and camber.

8. The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M.) by means of templates of while the necessary of the in between shall be tested by strings and corrected as required.

9. The centre line shall first be marked in the subgrade which is properly consolidated and has uniform camber and grade as required.

10. The Q.S. shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.

11. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between them equal to the width to be laid with oversize metal Similarly.

12. The Q.S. shall be laid as close as possible so as to leave minimum possible interstices and voids.

13. Before rolling is allowed on soiling the side berms shall be filled upto the top of the soiling and at least 3'-0" (1 m.) on either side so as to prevent metal layer getting disturbed a. times during rolling. The rate is inclusive of all the operations as stated above.

ITEM-20

Rolling & Consolidating water bound macadam (except laterite & kankar) incl. watering not exceeding 150 mm thickness (main layer including binding materials) including filling in depression which occur during the process with power roller exceeding 8.0 M.T. but not exceeding 12.0 M.T.

1. Immediately following the spreading of the coarse aggregates rolling shall be with three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate and be indicated by Engineer-in-charge.
2. Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to center line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.
3. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave like motion in the sub-grade or sub-base course.
4. The rolled surface shall be checked transversely and longitudinal with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re-rolling until, the entire surface conforms to desired camber and grade. In no case shall the use of screening be permitted to make up depression.
5. The blinding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled, during which water shall be applied to the wheels of the rollers if necessary to wash down the blinding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the moving roller.
6. After the final compaction of water bound macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings of binding materials as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.
7. Payment will be made on Smt. basis of the finished work and shall include cost of watering, rent of machinery cost fuel, wages of drivers and cleaners and murrum bund etc.

ITEM NO. 21 :- Construction of granular sub-base by providing close graded material / coarse graded material, mixing by mix in place method, mixing in a mechanical mix plant at OMC, carriage of mixed material to work site spreading in uniform layers with motor grader on prepared surface and compacting with smooth wheel roller or vibratory power roller, to achieve the desired density, complete as per Technical Specification Clause 401.

401. Granular sub Base**Scope:-**

This work shall consist of laying and compacting well-graded B.T. 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-bas hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2 Materials:-

The material to be used for the work shall be natural sand, murrum, gravel, crushed stone or combination thereof depending upon the grading required. Materials like crushed slag crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The materials shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 400-1.

While the gradings in Table 400-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53mm and 26.5 mm, the corresponding gradings for the coarse graded materials for each of the three maximum particle sizes are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

401.2.2 Physical requirements :-

The materials shall have a 10 percent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812(Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3), if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

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

IS Sieve Designation	Per cent by weight passing the IS Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100

9.5 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

TABLE 400-2, GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

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

Note: The material passing 425 micron (0.425 mm) sieve for all the three grading when tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 percent respectively.

401.3 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.

401.4 Construction Operations:

401.4.1 Preparation of subgrade:-

Immediately prior to 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 3) 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. According to need to obtain required Compaction & as per instructions of Engineer-in-charge Contractor shall use required Rollers in order to obtain required compaction and as per instructions of Engineer-in-charge, contractor shall use smooth wheeled / vibratory roller of 80 to 100 KN static weight. Rolling shall commence at edges & progress towards 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 cross fall (Camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km. Per hour.

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

401.5 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.

401.6 Arrangements for Traffic :-

During the period of construction, arrangement of traffic shall be maintained in accordance with clause 112.

401.7 Measurements for payment :-

During 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

- (i) making arrangements for traffic to Clause 112 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 lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the specifications
- (iv) carrying out the work in part widths of road where directed; and
- (v) carrying out the required tests for quality control.

ITEM-22 Providing and laying W.B.M. Sub base/Base course)

- 1.0 Specifications for W.B.M. : (Sub base/Base Course) crushed/broken stone aggregates of ___ mm compacted thickness rolling and bonded together with screenings B.T.M.C. metal of size 45 to 63 mm size including 20% grit (Stone Screening) & stone dust as filler including spreading water & consolidation by required roller as per specification.

2.0 Materials :

2.1 Coarse aggregates : General requirements : The coarse aggregates shall be stone metal obtained from quarries approved by the Executive Engineer prior to collection. The metals shall be of approved quality with all leads and lifts. The metal shall be obtained from hard, tough, sound, durable, stone of close texture as is locally available and reasonably free from decay and weathering. Pieces of the stone shall be angular and roughly cubical in shape and round, elongated or flaky materials shall be rejected. No round or oblong pebbles or angular chips larger or smaller than specified size shall be allowed. The size of metal shall be 40 mm to 63 mm and shall be crushed/hand broken. All unsound weathered or disintegrated tone obtained from the upper surface layer of the quarry or other layers & boulders shall be rejected.

2.1.1 Physical requirements : The aggregates shall conform to the physical requirements as indicated in the Table No. 400-1 hereafter.

TABLE 400-1 PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE COURSES

Test	Test Method	Requirement
1. * Los Angeles Abrasion value Or * Aggregate Impact value	IS:2386 (Part-4) IS: 2386 (Part-4) or IS:5640**	40 per cent (Max) 30 per cent (Max)
2. Combined Flakiness and Elongation - Indices (Total)	IS:2386 (Part- 1)	30 per cent (Max)

* Aggregates may satisfy requirements of either of the two tests.

** Aggregates like bricks, metal, kankar, laterite etc. which get softened in presence of water, shall be tested for impact value under wet condition in accordance with IS : 5640

2.1.2 Grading requirement : The coarse aggregates shall conform to the grading requirement as indicated in Table No. 2 below :

TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing the sieve
1.	90 mm to 45 mm	125 mm 90 mm 63 mm	100 90-100 25-60

		45 mm	0-15
		22.4 mm	0-5
2.	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3.	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

2.2 Screenings/approved quality of murrum/gritty materials : Screenings/murrum/gritty materials to fill voids in the coarse aggregate and to act as binding materials shall generally consist of predominantly non-plastic material such as murrum or gravel (other than rounded river borne material) provided the liquid limit and plasticity index of the material is below 20 & 6 respectively & fraction passing 75 micron sieve does not exceed 10 percent.

2.2.1 As far as possible, screening/murrum/gritty materials shall conform to the gradings set forth in Table No. 400.3 below :

TABLE 400 - 3. GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per Cent by weight passing the IS sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micn	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micn	15-35

TABLE 400 - 9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100 / 75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE / BASE COURSE FOR 10 M2 AREA

Classification	Size Range	Compact thickness	Loose Qty.	Screenings			
				Stone screening		Crushable type such as murrum or gravel	
				Grading classification and size	For WBM sub-base / base course	Grading classification and size	Loose Qty.
Grading1	90 mm to	100 mm	1.21 to 1.43 m ³	Type A 13.2 mm	0.27 to 0.30 m ³	Not Uniform	0.30 to 0.32 m ³
Grading2	63mm to	75 mm	0.91 to 1.07 m ³	Type A 13.2 mm	0.12 to 0.15 m ³	- do -	0.22 to 0.24 m ³
- do -	- do -	- do -	- do -	Type B 11.2 mm	0.20 to 0.22 m ³	- do -	- do -
Grading3	53mm to	75 mm	- do -	- do -	0.18 to 0.21 m ³	- do -	- do -
		22.4 mm.					

3.0 Construction Operations :

3.1 Preparation of base : The subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified grade and 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. Where water bound macadam is to be laid over an existing black topped surface, 50 mm x 50 mm furrows shall be cut at an angle of 45 degrees to the road at 1 metre intervals in the latter before laying the coarse aggregate.

3.2 Spreading course aggregate : The coarse aggregates shall be spread uniformly upon the prepared base in such quantities that the thickness of the compacted layer is 100 mm for grading 1 and 75-100 mm for gradings 2 and 3 as specified.

The spreading shall be done from stock piles along the side of the roadway or directly from vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncompacted or partially compacted base be permitted.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of

fine material.

The coarse aggregate shall not normally be spread more than 3 days in advance of the subsequent construction operations.

3.3 Rolling : Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 6 to 10 tonne capacity or tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and as may be indicated by the Engineer-in-charge.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall continue until the aggregate are thoroughly keyed and the creeping of aggregates ahead of roller is longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

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

3.4 Application of screenings/ murrum/ gritty material : After the coarse aggregate has been rolled to Clause 3.3 screenings/ murrum/ gritty material to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings/ murrum/ gritty material are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings/ murrum/ gritty material shall not be dumped in piles but spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreaders, or directly from trucks. Trucks operation for spreading the screenings/ murrum/ gritty material shall be driven as not to disturb the coarse aggregate.

The screenings/ approved quality murrum/ gritty material shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling and brooming of screening/ murrum/ gritty material shall be carried out in only such lengths of the road which could be completed within one day's operation.

3.5 Sprinkling and grouting : After the screenings/ murrum/ gritty material have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings/ murrum/ gritty material into void and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary, until the coarse aggregate has been thoroughly well-bonded and firmly set in full depth and a grout has been formed of screenings/ murrum/ gritty material. Care shall be taken to see that the base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

3.6 Setting and drying : After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings/ murrum/ gritty material as directed, slightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop having traffic from using the completed water bound macadam course if in his opinion it would cause excessive form to the surface.

4.0 Surface Finish :

The surface finish of construction shall conform to the following requirements :

4.1 General : All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer-in-charge subject to the permitted tolerances described hereinafter.

4.2 Horizontal Alignments : Horizontal alignments shall be reckoned with respect to the centre line of the carriage way as shown on the drawings. The edges of the carriage way as constructed shall be correct within a tolerance of ± 25 mm therefrom. The corresponding tolerance for edges the roadway and lower layers of payments shall ± 40 mm.

4.3 Longitudinal profile : The levels of the subgrade and different pavement course 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-in-charge, beyond the tolerances mentioned below:

Subgrade	± 25 mm	Sub-base	± 20 mm
Base course	± 15 mm	Wearing course	± 10 mm.

provided, however, that the negative tolerance for wearing coarse shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6 mm.

4.4 Surface Regularity : The surface regularity of completed sub-base, base course and wearing surface in the longitudinal and transverse directions shall be within the tolerance indicated in Table No.4 below:

Table No. 4: Permitted tolerance of surface Regularity for payment course

Sr. No.	Type of Construction	Longitudinal Profile with 3 metre straight edge		Cross profile
		Maximum permissible undulation mm	Maximum number of undulations permitted in any 300 m. length exceeding mm	Maximum Permissible variation from specified Profile under camber
1	2	3	4	5
1.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size)	12	30	8

The longitudinal profile shall be checked with a 3 metre long straight edge at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber at intervals of 10 metres.

4.5 Rectification : Where the surface irregularity of subgrade and the various pavement course fall outside the specified tolerances, the shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge.

When the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompact as per the specification of W.B.M. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

5.0 Quality Control tests during Construction :

5.1 General : The materials supplied and the works carried out by the contractor shall conform to the specification prescribed in the preceding Clauses.

For ensuring the requisite quality of Construction, the materials and works shall be subjected to quality control test, as describe hereinafter, by the Engineer-in-charge. The testing frequencies set forth are desirable minimum and the Engineer-in-charge shall have the full authority to carry out tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications.

Test procedures for the various quality control tests are indicated in the sections of the specifications or for certain test within this section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent engineering practice to the directions of the Engineer-in-charge.

5.2 Test on Sub-bases & Bases :

5.2.1 The tests and their frequencies for W.B.M. types of bases & sub-base shall be as given in Table No.5 below

Table No. 5 Control tests & their frequency for sub-base & bases of water bound macadam

Sr. No.	Type of Construction	Test	Frequency
1.	Water Bound Macadam	(i) Aggregate impact value (ii) Grading (iii) Flakiness index (iv) Aterberg limit	One test per 1200 cu.m. One test per 100 cu.m. One test per 200 cu.m. One test per 25 cu.m. of materials for screenings.

5.2.2 Compaction Control : Control shall be exercised by tacking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS 2720 (Part XX VIII). Test locations shall not be based on the results of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over materials and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc.

6.0 Arrangement of Traffic during Construction :

6.1 General : The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall, in accordance with the directives of the Engineer-in-charge, provided and maintain, during the execution of the work, a passage for traffic along a part of the existing way under improvement, or along a temporary diversion constructed close to the highway.

6.2 Passage of Traffic along a part of the Existing Carriage way Improvement : This method shall be adopted where, in the opinion of the Engineer-in-charge, the improvement works, namely widening of the existing pavement or reconstruction/repairs to cross-drainage works, could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part. The road shoulder shall be dressed and brought in line with the pavement and maintained throughout the duration of the work to the satisfaction of the Engineer-in-charge. Where works is in progress in continuous long stretches, passing places, at least 20 metre long 6 metre wide, inclusive of the width of the existing carriage way shall be provided at half to one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

6.3 Passage of traffic along a Temporary Diversion : If in the opinion of the Engineer-in-charge it is not possible to pass the traffic on part width of the carriage way for any reason, a temporary diversion close to the highway shall be constructed as directed. It shall be paved with locally available materials such as hard murrum, gravel, brick or stone metal to the specified thickness and provided with bituminous surfacing, where directed. In all case, the alignment, gradients and surface type of the diversion, including its junctions, shall be approved by the Engineer-in-charge before the highway is detoured and closed to traffic. At cross drainage points, the contractor shall provide temporary crossings for the diversion according to the designs approved by the Engineer-in-charge.

6.4 Traffic Safety and control : The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer-in-charge 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 programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

The barricades erected on either side of the carriage/portion of the carriage way 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 throughout from sunset to sunrise.

At the point where traffic is to deviate from its normal path whether on temporary diversion or part width of the carriage way 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-in-charge. At night the passage shall be delineated with lanterns or other suitable light source.

One way traffic operation shall be established wherever the traffic is to be passed over part of the carriage way inadequate for two-lane traffic. This shall be done with the help of 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 shall be installed for the guidance of road users. On each approach at least two signs shall be up put one close to the point where transition of carriage way begins and the other 120 metres away. The signs shall be of approved design and of refractory type if so directed.

6.5 Maintenance of Diversion and traffic control Devices : Signs, lights, barrier and other traffic control devices, as well as the riding surface of diversions shall be maintained in satisfactory conditions till such time they are required as directed by the Engineer-in-charge. The temporary travel way shall be kept free of dust by frequent application of water if necessary.

6.6 Measurements for payment traffic Arrangement : All arrangements for traffic during construction including maintenance thereof but excluding initial dressing and/or extra treatment of the shoulders and construction of temporary diversions shall be considered as incidental to the works and Contractor responsibility.

Construction of temporary diversions, initial dressing of the shoulders and extra paving at passing places shall, however, be paid for as provision sum, if written order is issued to do so by the Engineer-in-charge.

7.0 Measurements for payments for W.B.M.

7.1 Water bound macadam shall be measured as finished work in position is cubic metres. The finished thickness of sub-base and base courses to be paid on volume basis shall be computed in the following manner :

Levels shall be taken before and after construction, at a grid of points 10 metres centre to centre longitudinally in straight reaches but 5 metres at curves. Normally, on two-lane roads the levels shall be taken at four positions transversely, at 0.75 and 2.75 metres from either edge of the carriage way and on single lane roads these shall be taken at two positions transversely being at 1.25 metre from either edge of the carriage way.

Suitable reference for the transverse grid line should be left in the form of embedded bricks on either ends or by the other means so that it is possible to locate the grid points for level measurements after each successive course is laid.

For pavements courses laid only over widening portion, at least one line of levels shall be taken on each strip of widening or more depending on the width of widening as decided by the Engineer-in-charge, notwithstanding the above, if the need may arise particularly in the case of estimation of the volume of the material for leveling course. The average thickness of the pavement source in any area shall be the arithmetical mean of the difference of levels before and after construction at all the grid points falling in that area, provided that thickness of finished work shall be limited to those shown on the drawings or approved by the Engineer-in-charge.

As supplement to level measurement, the Engineer-in-charge shall have the portion to cut cores/holes to check on the depth of construction.

The contractor shall sign day to day leveling work and also original cross section, longitudinal section in token of his acceptance etc. The working sections both longitudinal and cross of the sub-grade shall be taken by the Engineer-in-charge before the actual W.B.M. work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily in token of his acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started no cognizance of any complaint taken. Merely not signing of the level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5 percent before commencement of WBM. WBM shall be maintained by the contractor to proper formation and grade till this item is finally measured and accepted by the Department. The measurement shall be taken on compacted WBM.

Any crack formation or screenings observed in between any layer of WBM work shall be deducted from the measurement, so taken and set quantity of WBM work shall be considered for payment.

8.0 Rate

8.1 The contract unit rate for water bound macadam sub-base/base course 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-6 except for initial treatment to 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 lifts.
- (iii) All labour, tool, equipment and incidentals to complete the work to the specifications and
- (iv) Carrying out the work in part widths of roadway where directed.

Item No. : 23 : Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mix plant carriage of mixed material by tipper to site laying in uniform layers with paver in sub-base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density. including scarifying existing asphalt surface as & where required.

406. WET MIX MACADAM SUB-BASE/BASE

406.1. Scope

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

406.2. Materials

406.2.1. Aggregates

406.2.1.1. Physical requirements: Course aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent 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 400-10 below.

**TABLE 400-10. 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 impact value.	IS: 2386 (PART-4) IS: 2386 (PART-4) or IS: 5640**	40 percent (Max) 30 percent (Max)
2. Combined Flakiness and Elongation indices (Total)	IS: 2386 (PART-4)	30percent (Max)**

* Aggregate may satisfy requirements of either of the two tests.

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. 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 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

406.2.1.2. Grading requirements: The aggregates shall conform to the grading given in Table

TABLE 400 - 11 GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	% by weight passing the IS sieve	TS Sieve Designation	% by weight passing the TS sieve
53.00 mm	100	4.75 mm	25-40
45.00 mm	95-100	2.36 mm	15-30
26.50 mm		600.00 Micron	8-22
22.40 mm	60-80	75.00 Micron	0-8
11.20 mm	40-60		

Materials 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 sieve or vice versa.

406.3. Construction Operations

406.3.1. Preparation of base: Clause 404.3.1 shall apply.

406.3.2. Provision of lateral confinement of aggregates: While constructing wet mix macadam, arrangement shall be made for the lateral 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 in Clause 407.4.1.

406.3.3. 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 forced/positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. For small quantity of wet mix work, 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-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size.

406.3.4. Spreading of mix : 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 finisher shall be self-propelled, having the following features:

- (i) Loading hoppers and suitable distribution mechanism
- (ii) 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.
- (iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

406.3.5. 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 up to 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 centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre.

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

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

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

406.4. 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 lay.

406.5. Surface Finish and Quality Control of Work

406.5.1. Surface evenness: The surface finish of construction shall conform to the requirements of Clause 902.

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

406.6. 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 material as applicable and recomputed in accordance with 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.

406.7. Arrangement for Traffic

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

406.8. Measurements for Payment

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

406.9. 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 listed in Clause 401.8.

Item No. 24 :- Prime Coat over granular base providing & applying priming coat using medium setting emulsion bitumen @ _____ on W.B.M./W.M.M. surface by mechanical means including cleaning the surface etc. complete.

502. PRIME COAT OVER GRANULAR BASE

502.1. 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.

502.2. Materials

502.2.1. Primer: The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

- (i) Surfaces of low porosity, such as wet mix macadam and water bound macadam, (ii) Surfaces of medium porosity, such as cement stabilized soil base,
- (iii) Surfaces of high porosity, such as a gravel base.

502.2.2. 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 these 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 60°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

502.2.3. Choice of primer: 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.

502.3. 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 10°C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

502.4. Construction

502.4.1. 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 in narrow strips shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

502.4.2. Preparation of road surface: The surface to be primed shall be prepared in accordance with Clauses 501.8 and 902 as appropriate. 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 interlocked 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.

502.4.3. Application of bituminous primer: The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. Where a geosynthetic is proposed for use, the requirements of Clauses 703.3.2 and 703.4 shall apply. 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.

502.4.4. 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.

502.4.5. Tack coat: Over the primed surface, a tack coat should be applied in accordance with Clause 503.

502.5. Quality Control of Work

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

502.6. Arrangements for Traffic

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

502.7. Measurement for Payment

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

502.8. Rate : The contract unit rate for prime coat with adjustments as described in Clause 502.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of 0.75 kg per square metre, 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.

ITEM - 25 : Providing & Supplying evenly Tack Coat with bitumen at rate of 10Kg/smt. (including heating the bitumen but excluding the cost of bitumen).

503 TACK COAT:

503.1. Scope : This work shall consist of the application of a single coat of low viscosity liquid bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

503.2. Materials

503.2.1. Binder: The binder used for tack coat shall be Rapid Setting Bitumen Emulsion Grade RS-1 complying with IS:8887 of as specified in the Contract a type & grade.. The use of put back bitumen medium Curing grade as per IS:217 bitumen as per IS:217 shall be restricted only for sites at sub-zero temp return Statyfe or for emergency applications as directed by the Engineer. or as directed by the Engineer the use of cut back

503.3. Weather and Seasonal Limitations

Specifications shall be same as that of Item no. 502 except that Where the tack coat is of cut back bitumen, the surface shall be dry.

503.4. Construction

503.4.1 Equipment : Same equipments shall be used as per item 502.4.1.

503.4.2 Preparation of base : The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clause 501.8 and 902 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, or by other means as directed by the Engineer.

503.4.3 Application of Tack coat : The application of tack coat shall be at the rate specification in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in Table 500.2. The normal range of spraying.

TABLE 500.2 : RATE OF APPLICATION OF TACK COAT

Type of Surface	Quantity of Bituminous Material to be applied per square metre area
(i) Normal bituminous surfaces	0.20 to 0.25
(ii) Dry and hungry bituminous surfaces	0.25 to 0.30
(iii) Granular surfaces treated with primer	0.25 to 0.30
(iv) Non Bituminous Surfaces	
a. Granular base (Not primed)	0.35 to 0.40
b. Cement Concrete pavement	0.30 to 0.35

Temperature for a bituminous emulsion shall be 20°C to 70°C and for a cutback 50°C to 80°C if RC-70/MC-70 is used.

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

503.5. Quality Control of Work

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

503.6. Arrangements for Traffic

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

ITEM-26 Supplying of machine crushed stone aggregate chipping etc. of hard stone following nominal size free of disintegrated pieces deleterious and organic matter including filling the boxes with all lead and lift etc. complete on site of road.

(a) Kapchi and (b) Grit

1. Stone chips shall consist of regular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, and shall be free of elongated and flaky pieces, soft and disintegrated materials, and vegetable or deleterious matter. They shall satisfy the quality requirements set forth as shown hereafter.

Sr. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value	IS : 2386 (part IV)*	35% Maximum
2	Aggregate Impact Value	-do*	30% Maximum
3	Flakiness Index	IS : 2385 (Part D)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Water Absorption	IS : 2386 (Part III)	2% Maximum

* Aggregate may satisfy requirement of either of the two tests.

Size of stone chips shall be as under :-

(a) Kapchi : 12 mm size : Passing 20 mm sieve and retained on 10 mm sieve.

(b) Grit : 5 mm size : Passing 10 mm sieve and retained on 2.36 mm sieve.

3. The samples of stones chips collected from approved quarries shall be got tested at Government recognised laboratory as may be directed to the contractor at his own cost. The result shall conform to the standard requirements laid down in para (i) above. Collection of stone chips as per approved samples shall be allowed by the Engineer-in-charge. Testing charges shall be borne by the contractor. Payment at full rates for the stones chips shall not be made till the test results from the laboratory are received and found acceptable.

4. Stacking shall be done by filling in standard steel boxes of 2.0 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent, otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks in any hectometre is not confirming with the cubic content of the standard pharas (2.5 m x 1.5 m x 0.5 m) it shall be got corrected by the Contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the Contractor. If the quantity in any stack in a particular hectometre is found to be less than the standard measurements viz., 1.5 cmt, the entire collection in the hectometre shall be paid on the quantity of the smallest stack so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking shall be done in a manner as directed by the Engineer-in-charge.

5. The collection shall always commence at one end of the Kilometre and be carried out continuously towards the other end, unless the Engineer-in-charge directs otherwise.

6. Control on quality of material shall be exercised by the Engineer-in-charge by carrying out the following tests at the frequencies shown against each.

Sr. No.	Type of Construction Material	Test	Frequency
1.	Grit/Kapchi for open graded Carpet and seal coat.	(i) Aggregate impact value	One test per 100 cu.m.
		(ii) Flakiness Index of aggregate	One test per 100 cu.m.
		(iii) Stripping value & water absorption of source of supply subsequently	initially one set of 3 representative specimens for each
	aggregates	the quality of aggregates.	when warranted by changes in
		(iv) Grading of aggregates	One test per 100 cu.m. of aggregate

7. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall be responsible for preserving the materials throughout the period the contract remains in force. The use of materials shall not be allowed till the materials conveyance to the site with all lead and lift and filling boxes including all labour, tools, equipment and other incidental expenses.

ITEM - 27(A) Supplying and Stacking 80/100 asphalt as per requirement including carting, stacking, and protecting on road side etc. complete. (If asphalt is supplied by Department)

1. Bitumen shall be issued by the Department at the rate and place mentioned in Schedule 'A' of the tender. It shall have to be carted by the contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to P.W.D. store from where they are issued or as directed, if so provided in Schedule 'A' Any damage caused to the asphalt drum or loss of asphalt after issue from the store shall be the responsibility of the contractor. Drums of asphalt shall be so stored as to allow easy inspection and in such place a will not damage the drums and cause leakage or allow water and other foreign matter to enter. (dilate may be included in labour)

2. Bitumen shall be issued by department in bulk at the rate and places as shown in Schedule-A. For bulk asphalt contractor shall have to make adequate arrangement taking bulk asphalt at plant site according to requirement.

Bulk asphalt shall be used as per instructions of the Engineer in charge of work. The tanker of bulk asphalt should be unloaded in asphalt tank or in empty drums on site of work as directed Proper rate for carting shall be deducted as per carting rate, if the bulk asphalt is given on site of work instead of place shown in Schedule-A. The carting of bulk asphalt shall be made by the contractor from Koyali Refinery as per Schedule-A.

Keeping Records :

The department shall keep a day to day account of the supply and use of the asphalt in separate bound registers having numbered pages and in the proforma prescribed by the department. The contractor's responsible representatives shall also sign day to day in the register.

3. The payment shall be made on tonnage basis.

4. The contract unit rate of supplying bitumen shall include

- (1) Obtaining the bitumen from the Department.
- (2) Transporting to site.
- (3) Storing, stacking and protecting
- (4) Keeping record of supply and use and

(5) Returning of handing over the empty drums in good condition to the Department if so provided in Schedule 'A'.

ITEM - 27(B) Supplying and Stacking 80/100 asphalt as per requirement including carting, stacking, testing and protecting on road side etc. complete. (If asphalt is supplied by Contractor)

1. Bitumen shall be procured directly from refinery by the Contractor. The contractor shall make adequate arrangements for storing bulk asphalt at plant site. The Contractor will produce in original the bill of Refinery, all the gate passes issued by the refinery and the number of transport tanker. The Contractor will also produce the Test Certificate regarding the grade of asphalt issued by Refinery. The Department does not undertake to furnish "P" form (regarding Sales Tax Concessions) for purchase of asphalt.

2. On receipt and storage of bitumen, The bitumen shall be got tested in GERI Laboratory or other Laboratories approved by R. & B. Department. The frequency of test is specified in Para 5.

3. The Contractor will establish on site of work site laboratory in area not less than 25 sq.m. with pucca construction and equipped with instruments to enable to carry out the following tests.

1. Penetration test as per I.S. 1203
2. Softening point test as per I.S. 1204
3. Ductility test as per I.S. 1208
4. Viscosity test as per I.S. 1206
5. Specification Gravity test as for I.S. 1202

The above instruments should be certified as per I.S. standard, the same should be regularly calibrated and should be maintained in efficient condition.

4. The Registers for use, temperature and other quality requirements of bitumen will be maintained at Plant site. The registers will be printed, as per formats approved by R.&B. Department and authorised for use by the Engineer-in-charge. The entries in the registers will be made by the departmental representative and signed by the contractor or his authorised representative.

5. Frequency of Tests :

As regards quality of binder, three tests of one sample per two tankers will be done on plant site. The tests will be carried out as per Table 900.4 of Section 900 of M.O.S.T. standard specifications. The frequency of use of specifications will be as under :

No. of Tanker	No. of Tests	No. of Tanker	No. of Tests
Upto 10	One	50 to 100	Four
11 to 20	Two	For further every 50 tanker	One
20 to 50	Three		

ITEM-28 Scarifying gravelled macadam of bitumen macadam surface 6 cm to 10 cm. depth including stacking useful materials on road side and depositing or remaining stuff.

1.0 The layer of the existing layer metalling shall be excavated and shall be screened on site of work. Stacking of 75% of metal obtained from screening shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent, otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas (2m x 1.5 m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in any stack in a particular hectometer is found to be less then the standard measurements viz. 1.5 cmt. the entire collection in the hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge.

2.0 The remaining material except 75% of metal obtained from screening process shall be used in embankment with all lead and lift. It shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited else where and subsequently convey to site of deposition. The sequence of operations should be arranged properly. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in manner approved by the Engineer-in-charge. The material utilised in the embankment will be deducted from the net quantity of earthwork in embankment arrived at within the chainage measured.

3.0 The payment shall be made on sq. mt. basis, the contractor shall maintain all stacks in regular and proper size till the whole materials shall not be measured and finally accepted by the department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometerwise.

4.0 The rate includes the cost of scarifying macadam, screening, depositing, conveyance with all lead and lift, filling the boxes including all labour, tools, equipments and all other incidental expenses.

ITEM-29 (1) Surface dressing one coat with paving bitumen using 18 kg. bitumen per 10.0 Sq.m. with 0.15 cum of Stone chipping 12 mm. nominal size per 10.0 sq.m of road surface excluding rolling and consolidation (stone chipping and bitumen shall be paid separately).

(2) Surface dressing in two coats with bitumen using 18 Kg. per 10sqm. with 0.15 sqm of stone chipping 12mm nominal size per 10sqm. for first size 11kg. of bitumen with 0.10cum of stone chipping 10mm nominal size per 10sqm. of road surface for second coat excluding consolidation etc. complete. (stone chipping and bitumen shall be paid separately)

1. DESCRIPTION

This work shall consist of the application of one coat of surface dressing, consisting of a layer of bituminous binder sprayed on a base prepared previously followed by a cover of stone chipping properly rolled to form a wearing course to the requirements of these specifications.

2. MATERIALS

2.1 Stone chipping : The machine crushed B.T. stone chipping shall consist of fairly cubical fragments of clean, hard, tough and durable rock of uniform quality throughout. These shall be obtained by crushing B.T. stone. The chipping shall be free of elongated or flaky pieces, soft or disintegrated stone, salt, alkali, vegetable matter, dust and adherent coatings.

2.2 Binder : The binder shall be straight run bitumen of 80/100 or 60/70 penetration and satisfying the requirement of I.S. 73 or other type of bitumen as may be approved by the Department.

Necessary storage arrangements i.e. provision of tanks etc. for bulk asphalt shall be done by the contractor without any extra charges.

In the case of bitumen is to be supplied by Department in bulk at the rate and place shown in Schedule "A" for bulk asphalt, contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site, according to requirement. If the asphalt is supplied as bulk on plant site, the rate of conveyance for lead difference from store to plant site shall be recovered at S.O.R. for Qty of asphalt supplied.

2.3 Keeping Records : The Department shall keep a day account of the supply and use of the asphalt in separate bound register having numbered pages in the proforma prescribed by the Department. Day to day signature of the responsible contractor or his representative as may be directed by Engineer-in-charge shall be obtained in this register. The register shall be maintained by the Department and shall be produced with each bill.

TABLE . Physical requirements of aggregates

Sr. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value*	IS : 2386 (Part IV)	40% Maximum
2	Aggregate Impact Value*	- do -	30% Maximum
3	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Soundness		
	(i) Loss with Sodium Sulphate 5 cycles		12%
	(ii) Loss with Magnesium		18%
6	Water Absorption	IS : 2386 (Part III)	1% Maximum

* Aggregate may satisfy requirements of either of the two tests.

Note : If crushed slag is used, Clause 404.2.3 shall apply.

Requirements of stone chipping and binder content for surface dressing for 10 sq. mt.

Sr. No.	Type of Construction	Nominal Size of stone chipping	Specifications percent passing through Sieve and retained on Sieve	Quantity of materials	Binder content
1.	Single coat surface dressing of first coating of two coat surface coating	12 mm	Passing 20 mm Sieve & Retained on 10 mm Sieve	0.15 CM	18 kg
2.	Second Coat of two coat surface dressing	10 mm	Passing 12 mm Sieve & retained on 4.5 mm sieve	0.10 CM	11 kg

3. CONSTRUCTION OPERATION

3.1 Weather & seasonal limitations : The surface dressing work shall be carried on only when the atmospheric temperature in shade is above 15° C. No bituminous materials shall normally be applied when the surface of cover material is damp, when the weather is foggy or rainy or during dust storms.

3.2 Preparation of base : The base on which surface dressing is to be laid shall be prepared, shaped and conditional to the specified lines, grade and cross section as directed by the Engineer-in-charge.

The surface shall be thoroughly swept and scraped cleans of dust and any other extraneous matter before the spraying of binder. As necessary the cleaning shall be done first with hard brushed, then with softer brushes and finally by blowing with sacks or gunny bags.

3.3 Application of binder : Binders shall be heated to 163° C to 177° C. and sprayed on the dry surface in uniform manner with the help of self-propelled mechanical sprayers having, self-heating arrangement and bitumen pressure pump and spray nozzle bar capable of spraying bitumen uniformly at specified rate as given in above table. Excessive deposits of binder caused by stopping or starting of the sprayer or Through leakage or any other reasons shall be suitably corrected before the stone chipping are spread.

3.4 Application of stone chippings : The cover material i.e. machine crushed B. T. chips of 11.2 mm. nominal size shall be stacked on road side by filling standard boxes of 2.0 m x 1.50 m x 0.50 m the measurement shall be recorded in the measurement book after

collection in two kilometre length is complete. The material shall be cross checked by another D.E.E. as per rules. There after, the spreading shall be allowed. The permission of Engineer-in-charge shall be obtained before spreading.

Immediately after the application of binder, stone chippings in a dry and clean, state shall be spread uniformly on the surface, preferably by means of mechanical gritter, otherwise, manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings.

3.5 Rolling : Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tones three wheeled roller. Rolling shall commence at the edges and progress towards the centre except in super elevated portions, where it shall proceed from the inner edge to the other. Each pass of the roller shall uniformly be not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until aggregate particles are firmly bedded in the binder and present a uniform closed surface.

3.6 Application of second coat of surface dressing : Where surface dressing in two coats is specified the second coat shall be applied immediately after laying the first coat. The operation shall be the same as describe in para 8.3.3 to 8.3.5.

4. OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly surface dressed area until the following day. In circumstances, however, the Engineer-in-charge may open the road to traffic immediately after rolling, but in such cases its speed shall be limited to 16 km.per hour till the following day.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to requirements of M.O.S.T. No. 902 Specification.

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with section 900.

6. ARRANGEMENTS FOR TRAFFIC

During the period of construction flow of traffic shall be maintained as per clause-112.

7. MEASUREMENTS FOR PAYMENT

Surface dressing shall be measured as finished work in square metres.

8. RATE

The contract unit rate for surface dressing shall be payment in full for carrying out the required operations including full compensation for all components listed in item No.1 para 2.8

ITEM-30 Providing and laying 20/25mm thick bituminous open graded carpet with B.T. aggregates 0.66 cm/M.T. using bituminous for tack coat at the rate of @ rate of 10 Kg./10 Smt. on W.B.M. surface and 5 Kg./10 Smt. for B.T. surface and for mixing at the rate of 32.8 kg/M.T..of total mix i.e.3.28 per M.T. of total mix and heating asphalt & aggregate by continuous batching hot mix plant and spreading the same by paver finisher including consolidation with power road roller including providing equipment T & P oil, fire wood, kerosene labour charges etc. compt. using contractor's own machineries hot mix plant and paver finisher including flushing of sand 0.30 cmt/100 sq.mt.

1. The work shall consist of construction in a single course of 20/25 mm. thick premixed carpet as course, on a previously prepared base Single course shall also include additional thickness if any to remove unevenness of the existing surface.

2. The coarse aggregates shall consist of crushed stone only. These shall be clean, strong durable of fairly cubical shape, free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth as under.

Physical Requirements of Aggregates for Bituminous Macadam.

Sr. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS : 2386 (part IV)*	35% Maximum
2.	Aggregate Impact Value	- do - *	30% Maximum
3.	Flakiness Index	IS : 2386 (Part D)	30% Maximum
4.	Stripping Value	IS : 6241	25% Maximum
5.	Water Absorption	IS : 2386 (Part III)	2% Maximum

* Aggregates may satisfy requirements of either of the two tests.

3. The fine aggregates shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substance.

4. The filler, where required, shall be an inert material, the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime or fly ash approved by the Engineer-in-charge.

5. The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to the grading as under.

Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve for 20/25 mm thickness
20 mm	100

12.5 mm	70-100
10.0 mm	20-40
4.75 mm	0-5
2.36 mm	

6. The samples of aggregate of requires gradings for the work shall be got approved from the Engineer-in-charge prior to transportation and collection on plant site. Unapproved materials shall have to be removed from the plant site by the contractor at his own cost. If contractor fails to remove the inferior type of materials from the plant site, the same will be removed by the Department at the cost of the Contractor. Collection of aggregate shall be in different stacks according to various sizes of aggregates.
7. For the purpose of collection of materials, plant site shall be established at suitable place, where hot mix plant shall be installed. Department will extend all necessary co-operation in helping Contractor to get nearby Government land of establishing plant site. However, department is not responsible if no such land is made available to the Contractor and in that case, the Contractor will have to make his own arrangement for the same. Incoming material shall be recorded in a register for the purpose of record.
8. The binder shall be straight run bitumen of a suitable grade satisfying the requirements of IS:73. Bitumen shall be 60/80/100 grade and shall be supplied by the department at the rate and place as mentioned in Schedule 'A' of the tender and it shall have to be carted, by the Contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to P.W.D. Store from where they are issued or as directed, if so provided in Schedule 'A' Any damage caused to the asphalt drums or loss of asphalt after issue from store shall be the responsibility of the Contractor. Drums of asphalt shall be so stored so as to allow easy inspection and in such place as will not damage the drums and cause the leakage of allow water and other foreign matter to enter. For the purpose of calculating consumption, wastage will not be allowed beyond 2.5 percent. Excess consumption over 2.5 percent will be charged at a panel rate.
9. In case bitumen is to be issued by department in bulk, the same shall be issued to the Contractor at plant site by tankers at the same rate as shown in Schedule 'A'. Contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site according to the requirement. No deduction in rate will be made for supplying heated bulk asphalt.
10. The asphalt should not be used as a fuel. If however, Contractor is found to be using asphalt as fuel, the quantity of asphalt utilised shall be assessed, by the Executive Engineer whose decision will be final and binding to the Contractor who will be charged at double the rate provided in Schedule 'A' of the agreement even though the total consumption of asphalt may be within the theoretical consumption.
11. Department shall keep a day to day account of the supply and consumption of bitumen in a separate bound register having numbered pages and the proforma prescribed by the Department. Day to day signature of the Contractor's representative shall be obtained in this register. Issue rate of bitumen includes (i) Obtaining asphalt from Department's store, (ii) Transporting to site, (iii) Storing and stacking, (iv) Keeping records of supply and consumption and (v) returning the empty drums in good condition to the Department.
12. Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.
13. The base on which semidense carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.
14. The work shall consist of application of a single coat of bituminous to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.
15. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread of straight run bitumen for tack coat shall be 5 kg per 10 square meter area for an existing bitumen treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the on coming bituminous construction. In case carpet is to be laid on W.B.M. surface, rate of spread of Bitumen for tack coat will be 10 kg./10sqm.
16. The binder content for premixing shall be 3.28 percent by weight of the total mix unless otherwise specified. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.
17. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work. In order to obtain the required type of mix, the department may change the proportion of bitumen and gradings of aggregate and contractor shall have to collect the materials accordingly. In case of increase in proportion of bitumen the increased or decreased quantity will be adjusted at the rate provided in Schedule 'A'. The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job-mix formula and producing a uniform mix.
18. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one, having coordinated set of essential unit such as dryer for heating the aggregates, a binder heating and control unit for measuring out the correct quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregate.
19. The temperature of binder at the time of mixing shall be the range of 150° - 177° degree centigrade and of aggregates in the range of 155° - 163° degree centigrade. Provided also that at no time shall the difference in temperature between the aggregates and the binder exceed 14° degree centigrade.
20. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all the particles to the mineral aggregates are coated uniformly.
21. The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport

shall be clean and be covered over during transit if so directed by the Engineer-in-charge.

22. The mix, transported from the hot mix plant to the site, shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix, to specified grade, lines and cross sections. The temperature of mix at the time of laying shall be in range 121°-163° degree centigrade.

23. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm. from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

24. Immediately after the spreading of mix, it shall be thoroughly compacted by 8-10 tonnes 3 Wheel roller moving at a speed not exceeding 5 km per hour.

25. The roller wheels shall be kept damp to prevent the mix from adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except on super elevated portions. When it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

26. Sand or stone dust flushing at the rate of 0.03 cmt. / 10 smt. shall be done on asphalt surface for which no separate payment will be made.

27. Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

28. Surface finish and quality control of work : Control on the quality of materials and works shall be exercised by the Engineer-in-charge by carrying out the following test at the frequencies shown against each :

Sr. No.	Type of Construction	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application	At regular close intervals.
2.	Semi-Dense Carpet	(ii) Rate of spread of binder	Two test per day
		(i) Aggregate Impact Value	One test per 100 cu. m. of aggre.
		(ii) Flakiness Index of Aggre.	- Do -
		(iii) Stripping Value	- Do -
		(iv) Mix Grading	One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two test per day
		(v) Temperature of binder in the boiler, aggregate in the dryer and mix at the time of laying and rolling	At regular close intervals.
		(vi) Control of binder content and gradation in the mix (Binder Content test vide ASTM D-2172)	One test for each 100 tonnes of mix subject to max. of two test per day per plant
		(vii) rate of spread mix material	Regular control through checks on layer thickness

29. The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall in accordance with the directives if the Engineer-in-charge provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriage way under improvement or on diversion.

30. In case of the improvement works, namely widening strengthening of the existing pavement or reconstruction repairs to cross-drainage works. Where such works could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part; the road shoulder shall be dressed and brought in-line with the pavement and maintained throughout out the duration of the work to the satisfaction of the Engineer-in-charge. Where work is continued on long stretches, passing places, at least 20 metre long and 6 metre wide inclusive of the width of the existing carriage way shall be provided at half or one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

31. The contractor shall take the all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs, marking lights and flagmen as may be required, by the Engineer-in-charge 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 programme for the control of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

32. The barricades erected on either side of the carriage way/portion of the carriage way closed to traffic shall be strong 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 the channel for traffic shall be clearly marked with the aid of pavement marking, painted drums or a similar device to the direction of the

Engineer-in-charge. At night the passages shall be delineated with lanterns or other suitable light source.

33. One way traffic operation shall be established whenever the traffic is to be passed over part of the carriage way inadequate for two lane traffic. This shall be done with the help of flagmen kept positioned on opposite side 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 shall be installed for the guidance of carriage way begins and the other 120 metres away. The signs shall be of approved design and the refractory type if so directed.

34. The payment shall be made on the tonnage basis of the weight of mix of aggregate and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper 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 bridges. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

35. 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 Engineer, Junior Engineer or Supervisor, if so authorised. Record of each dumper will be maintained separately in bound 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 vehicles coming to the plants, site and out going from the plant site. The location of hectometre in which individual dumpers are unloaded shall be recorded carefully.

36. The contract unit rate for semidense carpet shall be in full for carrying out the required operation including full compensation for >

1. Making arrangements of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lifts.
4. All labour, tools, equipment and incidentals to complete the work to the specification.

ITEM-31 Providing and laying seal coat with 0.18 cum stone chips i.e. 0.2727 M. T. per 10 sq. mt. using 42.50 kgs of bitumen per M.T. (4.25% by weight) for mixing the aggregates, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu. m / 100 sq. mt.

1 DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base, to the requirement of these specification.

2 MATERIALS

2.1 Binder : The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 30 Para 2. Except that the upper limit for water absorption value shall be one percent.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filler : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregate including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by wt passing through Sieve	
	For type 'A'	For Type 'B'
12.5 mm	+	100
10 mm	100	70-100
4.75 mm	40-85	20-40
2.35 mm	5-20	5-20
75 micron	0-4	0-4

2.6 Proportioning of materials : The binder content for premixing shall be 42.50 kg per M.T. (4.25% by weight) for mixing aggregate. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of materials.

in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Premix seal coat shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150°C - 177°C and aggregates in the range of 150°C - 163°C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14°C .

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121°C - 163°C .

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than 100°C in any case the rolling shall be completed the temperature of mix falls about 80°C .

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

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

Department will be free to get some loaded dumper 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 proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained

separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

8. RATE

The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.7

Item No. 32 :- Providing and laying 25mm thick Semidense Bituminous concrete with drum mix plant using crushed stone aggregate of specified grading and stone dust as filler, premixed with asphalt / bitumen by weight of total mix at 5.00% (i.e. 50 kg/MT) and tack coat by emulsion asphalt _____ Sq.mt. transporting the hot mix to work site, laying with a paver finisher to the required grade / level and alignment, rolling with power roller / vibratory roller to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respects. Complete using contractors own machineries drum mix plant & paver finisher etc. complete or as specified.

508. SEMIDENSE BITUMINOUS CONCRETE

508.1 Scope

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing / binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25 mm to 100mm in thickness.

508.2. Materials

508.2.1. 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 500-15, for semi dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 521. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

508.2.2. Coarse aggregates: The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-14.

508.2.3. Fine aggregates: The fine aggregates shall be all as specified in Clause 507.2.3.

508.2.4. Filler: Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-14 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

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 shall fall within the limits shown in Table 500-15 for gradings 1 or 2 specified in the Contract.

508.3. Mixture Design

508.3.1. Requirement 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 500-14. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and elongation Index (combined) ²	Max 30%
Strength	Los Angeles Abrasion Value ³	Max 35%
	Aggregate Impact value ⁴	Max 27%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

The requirement for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

508.3.2. Binder content: The binder content shall be optimised 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 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

TABLE 500-15. COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35 - 40 mm	25 - 30 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90 - 100	100
9.5	70 - 90	90 - 100
4.75	35 - 51	35 - 51
2.36	24 - 39	24 - 39
1.18	15 - 30	15 - 30
0.6	-	-
0.3	9 - 19	9 - 19
0.15	-	-
0.075	3 - 8	3 - 8
Bitumen content % by mass of total mix ²	Min 4.5	Min 5.0
Bitumen grade (pen)	65*	65*

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

2. Determined by the Marshall method.

* Only in exceptional circumstances, 80/100 penetration grade may be used, as approved by the Engineer.

TABLE 500-16. REQUIREMENTS FOR SEMI DENSE BITUMINOUS PAVEMENT LAYERS

Minimum stability (kN at 60°C)	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
Percent air voids	3 - 5
Percent voids in mineral aggregate (VMA)	See Table 500-12
Percent voids filled with bitumen (VFB)	65 - 78

508.3.3. Job Mix Formula: The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-16 as obtained by the Contractors.

508.3.4. Plant Trials - permissible variation in job mix formula:

The requirements for plant trials shall be all as specified in Clause 507.3.4 and permissible limits for variation as shown in Table 500 - 13

508.3.5. Laying Trials: The requirements for laying trials shall be all as specified in Clause 507.3.5.

509.4. Construction Operations

508.4.1. Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

508.4.2. Preparation of base: The surface on which the Semi Dense Bituminous material is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate or as directed by Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

508.4.3 Geosynthetics - Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 703.

508.4.4 Stress absorbing layer - Where a stress-absorbing layer is specified in the contract, this shall be applied in accordance with the requirements of Clause 522.

508.4.5 Tack coat - Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

508.4.6 Mixing and transportation of the mixture - The provisions as specified in Clauses 501.3 and 501.4 shall apply.

508.4.7 Spreading - The general provisions of Clauses 501.5.3 and 501.5.4 shall apply.

508.4.8 Rolling - The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. 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.

508.5. Opening to Traffic

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

508.6. Surface Finish and Quality Control

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

508.7. Arrangement for Traffic

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

508.8. Measurement for Payment

The measurement shall be as specified in clause 507.8

508.9. Rate : The contract unit rate shall be as specified in Clause 507.9, except that the rate shall include the provision of bitumen 4.75 percent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

Item No. 33 :- Providing and laying Dense bituminous macadam of _____ thickness with B.T. Aggregates as per M.O.R.T.&H. gradation and emulsion asphalt for tack coat @ 2.50 Kg. / 10 Sq.Mt. with mechanical sprayer & bitumen grade 60/70 for mixing @ 40.00 Kg./M.T. i.e. 4% by weight of total mix including heating and mixing the aggregates and asphalt by continuous batching of drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including providing all materials, equipments, tools and plant, oil, kerosene, firewood, labour charges etc. comp. using contractor's own machineries, drum mix plant and paver finisher etc. complete.

507. DENSE GRADED BITUMINOUS MACADAM

507.1. Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM) for use mainly, but not exclusively, in base/binder and profile corrective course. DBM is also intended for use as a 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.

507.2. Materials

507.2.1. Bitumen: The specifications of requirements of bitumen shall be as per Clause No. 508.2.1

507.2.2. Coarse aggregates: The aggregates shall satisfy the physical requirements specified in Table 500-8, for dense bituminous macadam. The requirement shall be similar to that of Clause 504 except that aggregates shall satisfy physical requirements specified in Table 500-8.

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

507.2.3. Fine aggregates : Fine aggregates shall consists 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. 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 3) 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 500-8. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR DENSE GRADED BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and elongation index (combined) ²	Max 30%
Strength	Los Angeles Abrasion Value ³	Max 30%
	Aggregate Impact value ⁴	Max 24%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

* (the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

507.2.3. Fine aggregate: Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crusher-run screening, gravel, sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

507.2.4. Filler

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

The filler shall be graded within the following limits:

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

Mineral filler shall consist of rock dust, hydrated lime or portland cement, or after inert mineral matter approved by the Engineer. It shall be dry and free from lumps.

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 mass of total aggregate of portland cement or hydrated lime shall be added and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the gravel is limestone.

507.2.5. 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 shall fall within the limits shown in Table 500-10 for dense bituminous macadam gradings 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 500-10. COMPOSITION OF DENSE GRADED BITUMINOUS MACADAM PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	40mm	25mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45	100	100
37.5	95-100	100
26.5	63-93	90-100
19	-	71-96
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 ²	Min. 4.0	Min. 4.5
Bitumen grade (pen)	65 to 90	65 to 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.

2. Determined by the Marshall method.

507.3. Mixture Design

507.3.1. 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 500-11.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

TABLE 500-11. 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
Percent air voids	3 - 6
Percent voids in mineral aggregate (VMA)	See Table 500-12
Percent voids filled with bitumen (VFB)	65 - 75

507.3.2. Binder content: The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-11 and the traffic volume as specified in the Contract. 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 500-11 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

507.3.3. Job mix formula: The contractor shall inform the Engineer in writing at least 20 days before the start of the work. 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.

507.3.4. Permissible variation from job mix formula: It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

TABLE 500-13 PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

S. No.	Description of Ingredients	Permissible variation	
		Base/binder course	Wearing course
1.	Aggregate passing 19 mm sieve or larger	±8%	±7%
2.	Aggregate passing 13.2 mm, 9.5 mm	±7%	±6%
3.	Aggregate passing 4.75 mm	±6%	±5%
4.	Aggregate passing 2.36 mm, 1.18mm, 0.6mm,	±5%	±4%
5.	Aggregate passing 0.3mm, 0.15mm	±4%	±3%
6.	Aggregate passing 0.075 mm	±2%	±1.5%
7.	Binder content	±0.3%	±0.3%
8.	Mixing temperature	±10°C	±10%

507.3.5 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 501.

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.

507.4. Construction Operations

507.4.1. Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

507.4.2. Preparation of base: The base on which Dense Graded Bituminous Macadam is to be laid shall be prepared in accordance with Clause 501 or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical broom cannot reach, other approved method shall be used as directed by the Engineer.

5.7.4.3 Geosynthetics: Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 70.3

507.4.4. Stress absorbing layer: Where a stress absorbing layer is specified in the contract, this shall be applied in accordance with the requirements of Clause 522.

507.4.5 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 Clause 502 or as directed by the Engineer.

507.4.6 Tack Coat: Where the material on which the dense bituminous macadam is to be placed is bitumen bound surface, a tack coat shall be applied as specified, in accordance with the provisions of Clause 503 or as directed by the Engineer.

507.4.7 Mixing and transportation of the mixture: The provisions as specified in Clause 501.3 and 501.4 shall apply.

507.4.8 Spreading: The provisions of Clause 501.5.3 and 501.5.4 shall apply.

507.4.9 Rolling: The general provisions of Clause 501.6 and 501.7 shall apply, as modified by the approved laying trials. 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.

507.5 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.

507.6 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 work shall be exercised by the Engineer in accordance with Section 900.

507.7 Arrangements for Traffic: During the period of construction, arrangements for the traffic shall be done to Clause 112.

507.8 Measurement for Payment: Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tons or by the square metre at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

507.9 Rate: The Contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations as specified, and shall include, but not necessarily limited to all components listed in Clause 501.8.8.2 (i) to (xi). The rate shall include the provision of bitumen, at 4.25 per cent by weight of the total mixture.

The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly.

ITEM-34: Providing and laying bituminous 37.5 mm thick lean bound macadam in one or two layers considering 0.66 cum. per M.T. mix materials with machine crushed stone aggregate and asphalt for tack coat @ the rate of 4 Kg / 10 sq. mt. (on metaled surface) / 2.5 kg per 10 sq. mt. (on existing B. T. surface) using 30 kg. of bitumen per asphalt including mixing the aggregate, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu.m / 100 sq. mt.

1. DESCRIPTION

The work shall consist of construction in one layers each 37.5 mm thick LBM on previously prepared base, to the requirements of these specifications.

2. MATERIALS

2.1 Binder: The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by the contractor to the site of work at his own cost.

2.2 Coarse aggregates: The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

2.3 Fine aggregates: The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filler: The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation: The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below:

Table : Aggregate gradation For LBM

Sieve Size		%by weight passing the Sieve		Sieve Size		%by weight passing the Sieve	
		37.5	75 m.m.			37.5	75 m.m.
40 mm		-	100	-		-	-
25 mm		100	75-100	4.75 mm		15-35	15-35
20.0 mm	70-100	60-95	2.36 mm	5-20		5-20	
10.0 mm	35-60	30-55	0.75 mm	0-5		0-5	

The above gradation is tentative. To achieve Correct quantity the contractor shall get the job mix formula for the mix approved by Engineer-in-charge before starting the work.

2.6 Proportioning of materials: The binder content for premixing shall be 3.0 percent by weight of the total mix. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material: The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in Individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation: Lean Bound Macadam shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base: The base on which LBM is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 2.5 kg per 10 square metre area for an existing bitumen treated surface and 4 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. At specified temperature, so as to provide uniformly rate and unbroken spread bitumen. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

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

Department will be free to get some loaded dumper 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 proportionate 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, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

7.2 In case of LBM, DBM and asphaltic concrete of thickness 50 mm and above, initial levels before commencement of the work and final levels after completion of the work will be taken as indicated below for working out the average thickness of pavement laid, also the actual area of work done will be measured and the quantity of the work actually done shall be computed in Cu.M. basis. The actual tonnage of the mix shall then be worked out based on the designed density, for broad cross check on the actual tonnage of total mix used in the works.

Surface levels before and after laying the pavement course shall be taken as below :

Cross profiles will be taken at least at every ten meters longitudinally as shown below :

- For single lane : Levels at 15 Cms & 75 cms. from both the edges and centre point. (Levels at 5 points)
- For double Lane : Levels at 15 Cms & 75 cms : 175 Cms. 275 Cms. from both the edges and the centre point. (Levels at 9 Points)
- Widening single to double lane : Levels at 15 Cms. from both the edges and the centre Carriage way (Up to 2 meters widening) point (Levels at 3 Points)

However, in special cases if necessary, the cross profiles may be taken at closer length upto 3 meters.

8. **RATE :** The contract unit rate for L. B. M. shall be for payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8.

Item No. 35 :- BITUMINOUS CONCRETE

509.1. Scope

This clause specifies the construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface. A single layers shall be 25 mm to 100 mm in thickness.

509.2. Materials

509.2.1. **Bitumen:** The bitumen shall be paving bitumen of Penetration grade 60/70 complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500.18, for bituminous concrete, or this bitumen as modified by one of the method specified in Clause 521, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

509.2.2. **Coarse aggregates:** The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-17.

509.2.3. **Fine aggregates :** The fine aggregates shall be all as specified in Clause 507.2.3.

509.2.4. **Filler :** Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-17 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

509.2.5. **Aggregate grading and binder content :** When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-18 for gradings 1 or 2 as specified in the Contract.

509.3. Mixture Design

509.3.1. **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 500-19.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

509.3.2. **Binder content:** The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-19 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.

509.3.3. **Job mix formula:** The procedure for formulating the job

TABLE 500-17. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index	Max 30% (combined) ²
Strength*	Los Angeles Abrasion Value ³	Max 30%
	Aggregate Impact value ⁴	Max 24%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

mix formula shall be generally as specified in Clause 507.3.3 and the results of test enumerated in Table 500-19 as obtained by the Contractor.

509.4. Plant trials - permissible variation in job mix formula:

The requirements for plant trials shall be all as specified in Clause 507.3.4, and permissible limits for variation as shown in Table 500-13.

509.3.5. Laying trials: The requirements for laying trials shall be all as specified in Clause 507.3.5.

509.4. Construction Operations

509.4.1. Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

TABLE 500-18. COMPOSITION OF BITUMINOUS CONCRETE PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	19mm	13mm
Layer Thickness	50-65 mm	30-45 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix ²	5.0-6.0	5.0-7.0
Bitumen grade (pen)	65	65

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

2. Determined by the Marshall method.

509.4.2 Preparation of base : The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clauses 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 locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

509.4.3 Geosynthetics : Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 703.

509.4.4 Stress absorbing layer : Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 522.

509.4.5 Tack coat : Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

509.4.6 Mixing and transportation of the mixture. The provision as specified in 8 Clauses 501.3 and 501.4 shall apply.

509.4.7 Spreading: The general provisions of clauses 501.5.3 and 501.5.4 shall apply.

509.4.8 Rolling: The general provisions of clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

509.5 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.

509.6 Surface Finish and Quality Control : The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of this Specification.

509.7 Arrangements for Traffic : During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112

509.8 Measurement for Payment : The measurement shall be all as specified in Clause No. 503.8

509.9 Rate : The contract unit rate shall be all as specified in Clause No. 507.9, except that the rate shall include the provision of bitumen³ at 5.5 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted

up or down, accordingly.

ITEM-36 : Liquid / Premixed seal coat (IRC type _____) with _____ cm. of aggregate / stone chippings of _____ Kg. / 10 mg. bitumen per road surface. excluding rolling consolidation (chipping & bitumen shall be paid).

513.1 Scope :

513.1.1 This work shall consist of the application of seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall (camber).

513.1.2 Seal coat shall be of either of the two types specified below :

- Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chips.
- Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

513.2 Materials :

513.2.1. **Binder :** the requirements of Clause 511.1.2.1 and 511.2.2.1 shall apply.

The quantity of bitumen per 10 square metres, shall be 9.8 Kg for Type A, and 6.8 Kg for Type B seal coat. Where bituminous emulsion is used as a binder the quantities for Type A and Type B seal coats shall be 15 Kg and 10.5 Kg respectively.

513.2.2. **Stone chips for type A seal Coat :** The stone chips shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They should be free of soft or disintegrated stone, organic or other deleterious matter. Stone chips shall be of 6.7 mm. size defined as 100 per cent passing through 11.2 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.09 cubic metre per 10 square metre area.

513.2.3 **Aggregate for Type B seal coat :** The aggregate shall pass 2.36 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metres per 10 Square metres area.

513.3. Construction Operations :

513.3.1 **Weather and seasonal limitations :** The requirements of clause 501.5.1 shall apply.

513.3.2 **Preparation of surface :** The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat materials, the surface shall be cleaned free of any dust or other extraneous matter.

513.3.3 **Construction of Type A seal coat :** Bitumen shall be heated to 150°C-163°C and sprayed at the rate specified on the dry surface in a uniform manner with a self-propelled mechanical sprayer as described in the Manual for Construction and supervision of Bituminous Works.

Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tonne smooth wheeled steel roller, 8-10 tonne static weight vibratory roller, or other equipment approved by the Engineer after laying trials if required. Rolling shall commence at the edges and progress towards the centre except in superelevated and unidirectional cambered portions where it shall proceed from the lower edge to the higher edge. While rolling is in progress, additional chips shall be spread by hand in necessary quantities required to make up irregularities.

513.3.4. **Construction of Type B Seal coat :** A mixer of appropriate capacity and type approved by the Engineer shall be used for preparation of the mixed material. The Plant shall have separate dryer arrangements for heating aggregate.

The binder shall be heated in boilers of suitable design, approved by the Engineer to the temperature appropriate to the grade of bitumen or as directed by the Engineer. The aggregates shall be dry and suitably heated to a temperature between 150°C and 165°C or as directed by the Engineer before these components are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued until the later are thoroughly coated with the former.

The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed.

As soon as a sufficient length has been covered with the premixed material, the surface shall be rolled with an 8-10 tonne smooth-wheeled roller. Rolling shall be continued until the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

513.4 **Opening to Traffic :** In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. In the case of Type A seal coat, traffic shall not be permitted to run on any newly sealed area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases traffic speed shall be rigorously limited to 16 Km. per hour until the following day.

513.5 **Surface Finish and Quality Control of Work :** The surface finish of construction shall conform to the requirements of Clause 902.

For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

513.6 **Arrangements for Traffic :** During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

513.7 **Measurement for Payment :** Seal coat Type A or B shall be measured as finished work, over the area specified to be covered, in square metres at the thickness specified in the Contract.

513.8 **Rate :** The contract unit rate for seal coat Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2 (i) to (xi).

ITEM - 37 : BITUMINOUS MACADAM

504.1. Scope

This work shall consist of Construction in a single course having 50 mm. to 100mm or multiple course of thickness of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Bituminous macadam is more Clauses 507, 508 and 509.

504.2. Materials

5.4.2.1 **Bitumen:** The bitumen shall be paving bitumen of 60/70 Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS:73, and of the penetration indicated in Table 500.4

5.4.2.2 **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 matter. 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 aggregates shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500.3.

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

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

TABLE 500.3 : PHYSICAL REQUIREMENTS FOR AGGREGATES FOR BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness	Grain size analysis	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness & Elongation Index (Combined) ¹	Max. 30 per cent
Strength	Los Angeles Abrasion value	Max. 40 per cent
	Aggregate Impact Value ²	Max. 30 per cent
Durability	Soundness ⁴	
	Sodium Sulphate	Max. 12 per cent
	Magnesium Sulphate	Max. 18 per cent
Water Absorption	Water absorption ³	Max. 2 per cent
Stripping	Coating and stripping of bitumen aggregate mixtures ⁵	Min. retained coating 95 per cent
Water Sensitivity ⁷	Retained Tensile strength	Min 80%

Notes: 1. IS:2386 Part 1

4. IS:2386 Part 5

2. IS:2386 Part 1

5. IS:2386 Part 3

The elongation test to be done only on non flaky aggregates in the sample

3. IS:2386 Part 4*

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%

* Aggregates may satisfy requirements of either of these two tests.

504.2.4 **Aggregate grading and binder content:** When tested in accordance with IS:2386 (Part 1) (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 500.4. The type and quantity of bitumen are also indicated in Table 500.4. for the grading specified in the contract. The type and quantity of bitumen and appropriate thickness, are also indicated for each mixture type.

504.2.5 **Proportioning of Materials :** The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500.4. The binder content shall be within a tolerance of \pm percent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900

TABLE 500.4 : COMPOSITION OF BITUMINOUS MACADAM

Mix designation Nominal aggregate size. Layer thickness IS Sieve (mm)	GRADING : 1 40 mm 80-100 mm	GRADING : 2 19 mm 50 - 75 mm
	Cumulative Per cent Passing by Weight of Total Aggregate	
45	100	
37.5	90-100	
26.5	75-100	100
19		90-100
13.2	35-61	56-88
4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10

0.075	0.8	0.5
*Bitumen content, % by weight of total mixture	3.1-3.4	3.3-3.5
Bitumen Penetration Grade	35 to 90	35 to 90

Notes : * Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5 per cent higher, subject to the approval of the Engineer.

The binder content shall be within a tolerance of ± 0.3 per cent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 1800. Asphalt 60/70 3.4 % by weight of total mix shall be used for mixing.

504.3. Construction Operations

504.3.1 Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

504.3.2 Preparation of the base: The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clause 501.8 and 902.3 as appropriate, and a prime coat shall be applied in accordance with Clause 502 where specified, or as directed by the Engineer.

504.3.3 Tack Coat : A tack coat in accordance with Clause 503 shall be applied as specified in the Contract documents or as directed by the Engineer. The provisions of Clauses 501.3 and 501.4 shall apply.

- (i) At the edges of the layers of material and at gullies and manholes.
- (ii) At the approaches to expansion joints at bridges, viaducts or other structures.
- (iii) As directed by the Engineer.

504.3.6. Rolling

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7.

Rolling shall be continued until the specified density is achieved, or where no density is specified until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

504.4 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. For control of the quality of materials supplied and the works carried out, the relevant provision of Section 900 shall apply.

504.5 Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay on account of the construction procedure adopted by the Contractor, the course shall be covered by a seal coat to the requirement of Clause 509 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for Traffic

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

504.7 Measurements for Payment : Bituminous macadam shall be measured as finished work in cubic metres or by weight in metric tonnes. Where used as regulating course or square meter at the specified thickness as indicated in the contract or shown on the drawing or as otherwise directed by the Engineer.

504.8 Rate : The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for, all components listed in Clause 501.8.8.2 (i) to (xi).

ITEM - 38 : BUILT-UP SPRAY GROUT

506.1 Scope

This work shall consist of a two-layer composite construction of compacted crushed coarse aggregates with application of bituminous binder after each layer and key aggregates on top for the second layer, in accordance with the requirements of these Specifications to serve as a base course and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. Thickness of the course shall be 75mm.

Built-up spray grout shall be used in a single course in a pavement structure.

506.2. Materials

506.2.1. Bitumen : Clause 504.2.1 shall apply.

506.2.2. Aggregates: The coarse aggregate shall conform to Clause 504.2.2.

The aggregate shall satisfy the physical requirements set out in Table 500-3. The coarse and key aggregates for built-up spray grout shall conform to the grading given in Table 500-7.

TABLE 500-7. GRADING REQUIREMENTS OF COARSE AND KEY AGGREGATES FOR BUILT-UP SPRAY GROUT

IS Sieve Designation	Per cent by weight passing the Sieve	
	Coarse Aggregate	Key Aggregate
53.0 mm	100	-
26.5 mm	40-75	-
22.4 mm	-	100

13.2 mm	0.20	40-75
5.6 mm	0.20	0.20
2.8 mm	0.5	0.5

506.3. Construction Operations

506.3.1. Weather and seasonal limitations: The provisions of Clause 501.5.1. shall apply.

506.3.2. Equipment: The provisions of Clause 505.3.2. shall apply.

506.3.3. Preparation of base: The base on which the built-up spray grout course is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross-sections in accordance with Clause 501 and 902. A priming coat where needed shall be applied in accordance with Clause 502 with suitable primer as directed by the Engineer.

506.3.4. Tack coat: A tack coat over the base shall be applied as per Clause 503.

506.3.5. Spreading and rolling coarse aggregates for the first layer: Immediately after the application of tack coat, the coarse aggregates in a dry and clean form shall be spread uniformly and evenly preferably by mechanical means at the rate of 0.5 cu.m. per 10 sq.m area. Immediately after spreading of the aggregates, the entire surface shall be rolled with a 80-100 kN smooth-wheeled roller. Rolling shall commence at the edges and progress towards the centre except in superelevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge.

After initial rolling, the surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate, followed by rolling.

Rolling shall be stopped before voids in the aggregate layer are closed to such an extent as to prevent free and uniform penetration of the binder.

506.3.6. Application of binder-first spray: The binder shall be heated to the temperature appropriate to grade of bitumen approved by the Engineer and sprayed on aggregate layer at the rate of 15 kg/10 sq. m. (in terms of straight-run bitumen) in a uniform manner with the help of mechanical sprayers capable of spraying bitumen uniformly at specified rates and temperatures.

506.3.7. Spreading and rolling of coarse aggregate for the second layer: Immediately after the first application of the binder, the second layer of coarse aggregates shall be spread and rolled to Clause 506.3.5.

506.3.8. Application of binder-second spray: The second aggregate layer shall then be given a binder spray at the rate of 15 kg/10 sq.m. (in terms of straight-run bitumen) to Clause 506.3.6.

506.3.9. Application of key aggregate: Immediately after second application of the binder, key aggregates in a clean and dry state shall be spread uniformly and evenly, preferably by mechanical means at the rate of 0.13 cu.m./10 sq.m. so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform application of the key aggregates. The entire surface shall then be rolled with a 80-100 kN smooth-wheeled roller to Clause 506.3.4. While rolling is in progress, additional key aggregates, where required, shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and key aggregates are firmly in position.

506.4. Surface Finish and Quality Control

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.

506.5. The built-up-spray-grout shall be provided with final surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

506.6. Arrangements for Traffic: During the period of construction, arrangement of traffic shall be done to Clause 112.

506.7. Measurements for Payment: Built-up spray grout shall be measured as finished work in square metres.

506.8. Rate: The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8 (i) to (xi).

Item No. 39 : Close graded premix surfacing / mixed seal surfacing

803.1. Scope :

512.1.1. This work shall consist of the preparation, laying and compacting of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

512.1.2. Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents.

512.2. Materials

512.2.1. Binder: The provisions of Clause 511.1.2.1 shall apply.

512.2.2. Coarse aggregates: The provisions of Clause 511.1.2.2 shall apply.

512.2.3. Fine aggregates: The fine aggregates shall consist of crushed rock/quarry sands, natural gravel/sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

512.2.4. Aggregates gradation: The coarse and fine aggregates shall be so graded or combined as to conform to one or the other grading shown in Table 500-26.

TABLE 500-26. AGGREGATES GRADATION FOR MIX SEAL SURFACING

IS Sieve Designation	Cumulative per cent by weight of total aggregate passing	
	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88-100
5.6 mm	52-88	31-52
2.8 mm	14-38	5-25
0.090 mm	0-5	0-5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metres area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.0 kg per 10 square metres area for Type A and Type B surfacing respectively.

512.3. Construction Operations: The provisions of Clause 511.1.3.1. Through 511.1.3.5. shall apply.

512.4. Opening to Traffic: Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature.

512.5. Surface Finish and Quality Control of Work: The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

512.6. Arrangements for Traffic: During the period of construction, arrangement for traffic shall be accordance with the provisions of Clause 112.

512.7. Measurements for Payment: Close-graded premix surfacing, Type A or B shall be measured as finished work for the area specified to be covered, in square metres at a specified thickness.

512.8. Rate: The contract unit rate for close-graded premix seal surfacing, Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2 (i) to (xi).

Item No. 40: Road marking with hot applied thermoplastic compound with reflectorising glass beads on bituminous surface providing and laying hot applied thermoplastic compound 2.5 mm thick including reflectorised glass beads @ 250 gms per sq.mt. area thickness of 2.5 mm exclusive of surface applied glass beads as per IRC:35. The finished surface to be level, uniform & free from streaks & holes.

803.1. General

The colour, width and layout of road markings shall be in accordance with the code of Practice of Road Markings with paints, I RC: 35, and specified in the drawings or as directed by the Engineer.

803.2. Materials

Road marking shall be of hot applied thermoplastic compound, and reflectorised paint specified in the item and the material shall meet the requirements as specified below.

803.3 Hot Applied Thermoplastic Road Marking

803.4.1 General:

- The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- The Thermoplastic compound shall be screeded /extruded or, 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 the drawings or as directed by the engineer.

803.4.2 Thermoplastic materials.

803.4.2.1 General:

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

803.4.2.2 Requirement:

In 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	18.0 min.	18.0 min.
Glass Beads	30 - 40	30 - 40
Titanium dioxide	10.0 min.	-
Calcium Carbonate and Inert Fillers	42.0max.	See Note
Yellow pigments	-	See Note

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

II Properties :

The properties of thermoplastic material, when tested in accordance with ASTM D36/8S-3262 (Part-I) shall be as below:

A) Luminance:

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

803.4.3 Reflectorizing glass beads:

803.4.3.1 General : The specification covers types of glass beads to be used for to production of reflectorised 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

803.4.3.2 The glass beads shall be transparent, colourless and free from milliness, dark particles and excessive air inclusions. This shall conform to the requirements spelt out in clause 803.4.3.3.

803.4.3.3 Specific requirements :

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	Percent Retained	
	Type 1	Type 2
1.18 mm	0 to 3	-
850 micron	5 to 20	0 to 5
600 micron	-	5 to 20
425 micron	65 to 95	-
300 micron	-	30 to 75
180 micron	0 to 10	10 to 30
Below 180 Micron	-	00 to 15

Roundness : the glass beads shall have a minimum of 70 percent true spheres.

Refractive index: The glass beads shall have a minimum refractive index of 1.50.

Free flowing properties : The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paints striping. They shall pass the free flow test.

803.4.3.4 Test methods : The specific requirement shall be tested with the following methods.

The requirements of gradation, roundness and refractive index of glass beads and the amount 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.

803.4.4 Application properties of thermoplastic material.

803.4.4.1 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.

803.4.4.2 The materials upon heating to application temperatures shall not exude fume-, which are toxic, obnoxious or injurious to persons property.

1.3.5 Preparation : The materials shall be melted in accordance with the manufacturer's instruction- 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.

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. **1.3.6 Properties of finished road marking:**

The stripe shall be not be slippery when wet.

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

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

The marking shall be deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic.

The stripe of marking shall maintain its original dimension3 and position.

The colour of yellow marking shall conform to IS colour no. 356 as given in IS : 164.

803.5 Reflectorised Paint : Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of clause 803.4.3

803.6 Application :

803.6.1 Marking shall be done by machine. For locations where painting cannot- be done by 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.

803.6.2 The thermoplastic materials shall be applied hot either by screeding 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.

803.6.3 The pavement temperature shall not be less than 10°C during application.

All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint. The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes 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.

803.6.4 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with appendices B and C of BS-3262 (Part-3).

803.6.5 The finished lines shall be free from irregularities 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 streaks.

803.7 Measurement for Payment :

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

803.7.2 In respect of markings line directional arrows and lettering, etc. the measurement shall be by numbers.

803.8 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.

803.9 SPECIAL TERMS AND CONDITIONS FOR THERMOPLAST PAINT WORK:

(1) Agency should carry out the such type of work by only of thermoplastic paint laying machine (power driven only) with temperature controller and automatic mixing arrangement of glass beads in required proportion.

(2) After completion of the laying of thermoplastic paint work, two years guarantee for durability and reflectivity as per M.O.S.T. specification for road and bridge works clause 803 should be given by the bidder in the writing.

(3) Guarantee security deposit shall be retained 1% of the cost of the item of thermoplast paint from the R.A. bills, which will be released after expiry of guarantee period.

(4) Agency who carry out the such type of work shall have an experience of carrying out similar type of work.

(5) Test certificates as per M.O.S.T specification for road and bridge works clause 803.3.2.2 (vi) should be furnished of reputed laboratory before.

Item No. 41 : Supplying and fixing Cat-Eye made out of ASA (Acrylic styrene acrylonitrile) injection high compressed moulding with reflector made of MMC reflector cube corner reflector design filled with tightly adhering polishing compound as per ASTM D 788 size 11.5 cm x 7 cm x 1.6 cm provided with bituminous adhesive 100 gm. with each unit for fixing (Engineer Grade) .

801.1 General

801.1.1.1 The colour, configuration, size and location of cat eye for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs, IRC: 67 or as shown on the drawings. Or as directed by the Engineer.

801.1.1.2 The cat-eye shall be reflectorised as shown on the drawings or as directed by the Engineer. It shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminum sheeting as per these Specifications.

801.1.1.3 In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informative signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

801.2 Materials

The various materials and fabrication of the cat eye shall conform to the following requirements:

801.2.1 The adhesive materials shall be of standard quality and it shall be high resistance quality against heavy moving vehicles.

801.2.2 The materials shall be used for the body of the delineator is of high density PVC materials.

801.2.3 The dimensions and size of the cat-eye shall be as per IS standard. The retro reflective sheeting used on the cat-eye shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

High intensity grade sheeting: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810).

TABLE 800.1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO. REFLECTION FOR HIGH INTENSITY GRADE SHEETING
(CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/ Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (MSHTO Designation M 268).

1.4 Installation

The Cat eye shall be installed directly on road surface, after cleaning completely by removing all dust and other foreign materials from the surface of the road.

1.5. Measurements for Payment

The measurement of Cat eye shall be in numbers, these shall be measured in NO.

1.6 Rate

The Contract unit rate shall be payment in full for the cost of making Cat-Eye, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

Item No. 42 : Road Delineators

805.1 General : The work covers supplying and fixing roadway indicators, hazard markers and object markers.

805.2 The design, materials to be used and the location of the road delineators shall conform to Recommended Practice for Road Delineators, IRC: 79, and to relevant drawings or as otherwise directed by the Engineer.

805.3 Measurements for Payment : The measurement shall be made in numbers of delineators fixed at site.

805.4 Rate : The contract unit rate for road delineators shall be payment in full compensation for furnishing all labour, materials, tools, equipment for preparing supplying and fixing at site and all other incidental costs necessary to complete the work to these Specifications.

Item No. 43 : Providing and fixing Hectometer Stone as per IRC type design including painting and lettering etc. complete (ii) Fixing in CC 1:5:10

The work covers the supply, painting, lettering and fixing of Hectometer stone.

The dimensions of the stones and the size, colour, arrangement of letters and scripts shall be as per I.R.C. - 26 type designs. The Hectometer stone shall be pre cast cement concrete 1:2:4 for which relevant specification shall be followed. The stone shall be bedded into the ground with adequate foundation in C.C. 1:4:8 as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge. The orientation and location of the stones shall be as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge.

MEASUREMENT OF PAYMENT

The measurement will be taken in Numbers of Hectometer stone fixed at site.

RATE

The contract unit rate for Hectometer stones shall be payment in full compensation for furnishing, all labour, materials including providing necessary reinforcement, tools, equipment and making the stones, painting and lettering and fixing at site and all other incidental costs necessary to complete the work to the specifications.

Item No. 44 : Providing and fixing Guard stone as per IRC type design including white washing etc. comp. (i) Fixing in earth

The guard stone shall be approved quality of pre-cast C. C. 1:2:4 including necessary reinforcement and of 20 x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cms. shall be chiseled dressed on all sides. The size, shape and dimensions of the guard stone shall be exact and shall be neatly dressed and finished.

The guard stone shall be fixed in earth. Rate includes all labour & curing etc. necessary for work. The exposed part of the guard stone shall be given three coats of white wash. Any excavation necessary for fixing to guard stones shall be done by the contractor at his own cost. The

measurement for payment shall be per Number of guard stone fixed in position.

RATE

The contract unit rate for Guard Stones shall be payment in full compensation for furnishing all labour, materials including providing necessary reinforcement, tools, equipment and making the stones white washing and fixing at site and all other incidental, taxes, costs, necessary to complete the work to these specifications.

Item No. 45 :- Providing and fixing ordinary Kilometer Stone of precast C.C. 1:2:4 including necessary reinforcements as per IRC type design and fixing in C.C. 1:4:8 including lettering and paints etc. complete.

1. Ordinary Kilometer stone shall be of approved quality of precast 1:2:4 RCC. as specified in the item.
2. The size, manner of fixing, painting and lettering of KM stone shall conform specification as per IRC - 8 (Type design for Highway kilometre stones). The fixing of KM stone shall be carried out in ordinary payment shall be made per No. of KM stone fixed in position.
3. Fixing in C.C. 1:4:8

The indicator stone shall be fixed in C.C. 1:4:8 which will consist of one part of cement, five part of good sand and ten parts of good brick bats, Rate includes all labour and curing etc. necessary for concrete.

4. Unit rate for ordinary kilometre stone includes the cost of all materials labour, tools, fixing finishing curing lettering and painting as directed by the Engineer-in-charge.
5. Payment shall be made carried out on number basis.

ITEM-46 Providing and fixing fifth kilometre stone of precast C.C. 1:2:4 including necessary reinforcement as per L.R.C. type design in C. C. 1:4:8 including painting and lettering etc. complete. (for N.H., S.H. and M.D.R.)

1. The work shall be carried out as per the item of ordinary kilometre stone except that the size of the fifth kilometre stone shall be bigger than that of ordinary kilometre stone as per L.R.C.-8 (Type design for highway kilometre stones). The fixing of K. M. stone shall be in ordinary concrete of grade specified in the item. The measurement for payment as well as the operation included in the unit rate shall be as per ordinary kilometre stone.

Item No. 47 :- Providing and fixing R.C.C. Indicator Stone of approved stone as per IRC type design in C.C. 1:4:8 including white washing etc. complete (i) Fixing in C.C. 1:5:10

1. Indicator stones shall be of approved quality and of the size 20 cm x 20 cm its length shall not be less than 80 cms. The top, 38 cm shall be chisel dressed on all sides. The size, shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stone shall be done by the contractor at his own cost. The measurement for payment shall be per number of indicator stone fixed in position.
2. The indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.
3. Unit rate of indicator stone includes the cost of all materials, labour, tools, fixing and white washing as directed by the Engineer in charge.

Item No. 48 :- (Route Marker Sign) Providing & fixing sign boards made out of 2mm aluminium sheet size ____ cms. square as per the design of IRC 67 1977. Pre treated with phosphating process & acid etching, coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro sheeting as per latest M.O.S.T. Specifications. Letters & numeral should be as per IRC 30-1968, 3.1m long stand post and frame fabricated either from suitable size iron angle of ____ mm & ____ mm. Painted with best quality epoxy coating. The fixing at site shall be in 1:2:4 CC block of size ____ cms. cms. for each leg, including excavation curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade

The sign board shall conform to IRC-67-1977 and ninth schedule of the motor vehicle Act. It shall be providing and fixed as directed by the Engineer in charge.

1.2 Traffic Signs having retro-reflective sheeting :

1.2.1 General Requirements :

The retro-reflective sheetings used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather resistant and show lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory by the manufacturer of the sheeting. The type of sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

1.2.2 High Intensity Grade Sheetting :

1.2.2.1 Encapsulated Lens Type :

This sheeting shall be of encapsulated lens type consisting of spherical glass lens elements, adhered to a synthetic resin and encapsulated by a flexible, transparent water proof plastic having a smooth surface. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E-810) as indicated in Table 300-1.

TABLE 800-1 ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/ Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90% of the values of retro reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75% of its original retro-reflectance.

1.3.2 Engineering Grade Sheeting :

This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical, resulting in a non-exposed lens optical reflecting systems. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard E-810) as indicated in Table 800-2.

TABLE 800-2 ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

Observation angle (in degrees)	Entrance angle (in degrees)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	14.5	7.5	2.0
0.5	+30	13	13	4.0	2.2	3.0	0.8

1.1.2.3 When totally wet, the sheeting shall not show less than 90% of the values of retro-reflectance indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50% of its original retro-reflectance.

1.1.3 Messages/Borders : The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut-outs. Screen-printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

1.1.4 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50% of the values of corresponding colour in Tables 800-1(a), 800-1(b) and 800-2 as applicable.

1.1.5 Cut out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 1.1.2) except those in black which shall be of non-reflective sheeting.

1.1.6 Colour : Unless otherwise specified, the general colour scheme shall be as stipulated in IS:5 "Colour for Ready Mixed Paints".

Blue IS Colour No.166 : French Blue

Red IS Colour No.537 : Signal Red

Green IS Colour No.284 : India Green

Orange IS Colour No.591 : Deep Orange

The colours shall be durable and uniform in acceptable but when viewed in day light or under normal headlights at night.

1.1.7 Adhesives : The sheeting shall either have a pressure sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's specifications.

1.1.8 Refurbishment: Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for type of material used for the sign and should thoroughly bond with that material.

1.1.9 Fabrication :

1.1.9.1 Surface to be reflectorised shall be prepared to receive the retro-reflective sheeting. The smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves between all cleaning and preparation operation and application of reflective sheeting/primer.

1.1.9.2 Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure sensitive adhesive shall be overlapped not less than 5 mm. Sheetting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only but jointing shall be used. Cut outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

1.1.10 Warranty Durability : For each lot of sheetings procured, the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheetings of high intensity grade and a 5 years warranty for the engineering grade and submit the same to the Engineer. In addition, a 7 years and a five years warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut-out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the contractor/supplier and passed on to the Engineer.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and following cleaning shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer AASHTO Designation M 268).

1.2 Installation :

1.2.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally signs with an area upto 0.9 sq.m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanised iron (G.I.). Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

1.2.2 All components of signs and supports, other than the reflective portion and G.I. Posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.

1.2.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. Posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

1.3 Measurements for Payment :

The measurement for standard cautionary, mandatory and information sign shall be in number of different types of signs supplied and fixed as per above details and specifications.

1.4 Rate :

The contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

Item No. 49 : Providing and fixing Village name boards made out of 2 mm aluminium sheet size 90 x 60 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphating process and 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. 310mm long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 C.C block of size 45 x 45 x 60 cms for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge (B) High intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 90 x 60 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 50 : For Curves / Parking ahead / speed limit / Hazard marker sign* Providing and fixing sign boards made out of 2mm aluminium sheet size ____ x ____ x ____ cms. equilateral triangle as per the design of IRC-67-1977 pre treated with phosphating 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; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75 x 75 x 6mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per instruction of Engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms. for each leg, including excavation curing etc. complete under the supervision of Engineer in charge. (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size ____ cm equilateral rectangle instead of size 60 x 45 cms rectangle. or as directed by Engineer-in-charge.

Item No. 51 : (Parking Ahead) Providing and fixing sign boards made out of 2mm aluminium sheet; size 150 x 90 cms. rectangle as per the design of IRC-67-1977 pre treated with phosphating 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 pos) stand post and frame fabricated from suitable size iron angle of 50x50x5mm 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. (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 150 x 90 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 52 : Providing and fixing Direction / Junction boards made out of 2 mm aluminium sheet size 244 x 122 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphering process and 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, 3.10 m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm. & 75 x 75 x 6 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards shall be as per the instruction of engineer in charge The fixing at site shall be in 1:2:4 C.C block of size 45 x 45 x 60 cms for each leg including excavation curing etc complete under the supervision of engineer-in-charge (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 244 x 122 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 53 : (Speed Limit) Providing and fixing sign boards made out of 2mm aluminium sheet; size 60 cms. diameter circle 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; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 C.C block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of Engineer in charge. (B) High Intensity Grade.

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 60 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 54 : (Hazard Marker Sign) Providing and fixing Sign boards made out of 2mm aluminium sheet size 90 x 30 cms. rectangle as per the design / drawing attached (IRC) pretreated with phospheting & 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 MOST Specification 3.1m long stand post and frame fabricated either from suitable size iron angle of 35x35x3mm & 50x50x5mm painted with best quality epoxy coatings in black and white bends. The details of symbol of inscription / numerals for each board shall be as per instruction of engineer in charge the fixing at site shall be in 1:2:4 C.C. block of size 45x45x60cms for each leg including excavation curing etc. complete under the supervision of engineer in charge (B) High intensity grade

Specification of Item No. 109 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 90 x 30 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 55 :- Painting lines, dashes, arrows, letters etc. on roads. Air fields and like in two coats with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter. (i) Over 10cm in width

Materials : The Road marking paint shall be confirm to IS 164-1951.

Workmanship : The painting of lines dashes arrows and letters on roads, air fields and like shall be carried out with road marking paint in two coats upto 10 cm. width.

Mode of Measurement and Payment : Letters figures and similar items etc. stops, commas, hyphens and like shall be deemed to be include in the item the rate per cm. height / width shall hold good irrespective of width of letter, figures or the thickness of lettering.

The Rate shall be for a Unit of one Sq.mt. basis.

ITEM 56 : Providing and laying uncoursed rubble masonry with hard stone of approved quality in foundations and plinth in cement mortar 1:6 (1 cement : 6 course sand) including levelling up etc. complete.

1. Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The stones when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS : 1124. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 15 cm.

2. Cement and sand shall be mixed in proportion as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement and sand shall be first mixed dry in the required proportion to obtain as uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water the same shall be retempered by adding water as frequently as needed to restore the requisite consistency, but this retempering shall be permitted only, within thirty minutes from the time of addition of water at the time of initial mixing.

4. The dressing of stone shall conform to the general requirements of dressing of stone covered in IS : 1129. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a

wooden mallet immediately on placement so that it is solidly bedded in mortar before the same has set. Clean chips and spalls shall be edges into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faced completely covered with mortar. Vertical joints shall be staggered as far as possible. Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement. Bell shaped bond stones or headers shall not be used.

5. At all angular junctions, stones at each alternate course shall be well bonded into the respective course of the adjacent wall. All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks are unavoidable, the masonry shall be raked in sufficient long steps to facilitate joining or new work with old. The stepping of taking shall not be more than 45 degree with horizontal wing walls. Abutments and piers etc. shall be carved up truly plumb or with the specified batter. Face work and hearting shall be brought up evenly. The top of each cours, however, shall not be levelled up by use of flat chips.

6. Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 4 cm on exposed face chips and spalls of stone may be used where necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stone to bring these upto the level of face stone. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

7. The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm. in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in the mortar. The hearting should be laid nearly level with facing and backing. Through bond stone shall be provided in masonry upto 60 cm. thickness and in case of masonry above 60 cm. thickness a set of two or more than bond stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stone (Porous lime stone and sand stones etc.) the bond stone shall extend only about two third into the wall, as through stone in such cases may give rise to penetration of dampness and therefore for all thickness of such masonry a set of two or more bond stones, overlapping each other by at least 15 cm shall be approved. One bond stone or a set of bond stones shall be provided for every 0.50 square metres of the masonry surface. Bond stones shall be stacked separately and marked to distinguish from other stones. Masonry work shall be started after sufficient number of bond stones are collected on site as directed by the Engineer-in-charge.

8. The quoins shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as such as possible and to avoid long vertical lines of joints.

9. The face joints shall not be more than 20mm thick, but shall be sufficiently thick to prevent stone to stone contact and shall be completely filled with mortar.

10. Greenwork shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly wet on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot weather all finished or partly completed work shall be covered for wetted in such manner as will prevent rapid drying. The racking of joints where necessary shall be done at the end of day's work when mortar is green.

11. The scaffolding shall be sound and strong to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

12. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good with the new work.

13. Stone masonry shall be measured cubic meters.

14. The contract unit for stone masonry work shall include the cost of all labour, materials, tools and plant, Scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above.

ITEM - 57 : Providing & fixing Flood gauge post of M.S. angle 75 x 75 x 6 mm incl Painting lettering & fixing in position ordinary C.C. 1:2:4 as directed

The flood gauge is to be fixed as per I.R.C. Standard Specification having 75 mm x 75 mm x 6 mm size, M.S. angle having height equal to 1.43 mt. It shall be fixed in C.C. 1:2:4 as per drawing. The painting shall be done applying one primer coat & three coats of oil paint as per requirement & as per drawing using approved paints including lettering for flood gauge marking as per I.R.C. std. & drawings.

The work shall be carried out and materials used shall be to the entire satisfaction of the Engineer-in-charge.

The rate inclusive of all materials and labour with carriage, fixing, painting etc. complete as per drawing and direction of the Engineer-in-charge.

The measurement & Rate paid shall be on Number basis of flood gauge fixed.

ITEM-58 : Providing and fixing junction Board of R.C.C. precast as per standard design of I.R.S. including fixing in C.C. block of 1:4:8 with necessary excavation enamel painting, lettering figures etc. complete.

1. These boards should be fixed at a distance of 120 metre from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.

2. The board will be located in such a way that the edge of the board towards the centre of the road will be at a distance of 4.57 metres from the centre of a National Highway and 3.66 meters from the centre of State Highway or Major District Road.

3. The bottom of the board should be 1 metre above the road surface and the board shall be at right angle to the centre line of the road facing the direction of traffic.
4. The board shall be of the size of 107 cm. in length and 91 cm. in height for "T" and "Y" junctions shall be 145 C.M. in length and 91 C.M. in height for cross roads.
5. The board shall be painted by two coats, the Board and posts shall be R.C.C. as shown in the type design.
6. The post shall be fixed in concrete and the projection of this above the road level shall be 45 cm x 45 cm and height of 24 cms. above the road level and the top to be finished in plaster from the height of 15 cm.
7. The size of letter and figures shall be 8 cm. for English and 10 C.M. for devnagri and Gujarati scripts.
8. The post shall be painted in black and white reflective strips 23 cm. in height.
9. The board shall be painted in white with border 2 C.M. wide.
10. On this board tablets shall be painted in yellow with black and the tablets shall have 5 cm. clear distance from the board.
11. Each such tablet shall be 61 cm. in length and 33 C.M. in height, arrow lines indicating the direction of the road at the junctions shall be painted in black and shall have a thickness of C.M. for National Highway and 4 C.M. on a State Highway and a C.M. for a Major district road.
12. All letters and figures shall be painted in black.
13. The work shall be carried out as per design as per the instructions of the Engineer-in-charge. The measurements shall be recorded and paid on number basis for board fixed in position.

ITEM-59 Providing & fixing Board of M.S. Plate with two angles iron post and fixing in C.C. Concrete 1:4:8

The size of the board shall be 110 cm in length & 60 cm in height. It shall be prepared from M.S. Plate of 6 mm thickness. The angle iron post shall be of size 75 mm x 75 mm and 6 mm thick. The length of iron post shall be 2.1 metres. The post shall be fixed to the board by welding. The welding shall be true and strong and neat in appearance.

The board shall be fixed in C.C. 1:4:8 concrete. The concrete block for each post shall be 30 cm x 30 cm in size. The depth of the concrete block shall be 85 cm of which 60 cm will be below ground and 25 cm above ground level. The exposed concrete block i.e. its portion above ground level shall be neatly finished and its shape should be truly square.

The post shall be painted with two coats of paint, alternatively in black & white strips 23 cms in height after applying one coat of anticorrosive paint. The paint shall be of approved quality. The board shall be painted with colour, as directed by Engineer-in-charge. The information as per instruction of Engineer-in-charge shall be written on board with letters & signs in accordance with I.R.C. The information may be one or more of the three script viz. Hindi, English & Gujarati.

The board shall be fixed truly vertical & workmanship of the board shall be neat, clean & good in appearance.

The measurement for payment shall be for number of board fixed in position & complete in all respect.

The unit rate includes cost of material, labour, tools, welding, concreting, painting, lettering etc.

ITEM - 60 U.C.R. Masonry for super structure in C.M. :

Para 1 to 14 item No. 56 of the roads specification booklet shall apply for the work of this item.

ITEM - 61 : Providing and laying coursed rubble masonry hard stone of approved quality for super structure and plinth in cement mortar 1:5 (1 cement : 5 course sand) etc. complete.

1. Para 1 to 14 of item of U.C.R. masonry shall apply.

15. Masonry shall be laid with course, where there is variation in the height of course. Large courses shall be placed at lower levels with height of courses decreasing gradually towards the top.

16. In case of abutment and wing walls, weep holes shall be provided in the masonry to drain moisture from the backfilling. Weep holes shall be 8 cm wide, 15 cm high or circular of 15 cm. diameter and shall extend through the full width of the masonry with slopes of about 12 vertical to 20 horizontal towards the draining face. The spacing of weep holes shall be generally 1 metre in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

ITEM-62 : Providing and laying Brick work using common burnt clay building bricks having crushing strength not less than 35 kg/sq.m. in foundation and plinth in cement mortar 1:5 (1 cement : 5 fine sand)

1. Burnt clay bricks shall conform to the requirements of IS: 1017, except that the minimum compressive strength when tested flat shall not be less than 35 Kg/square cm. and that the size may be according to local practice, with a tolerance of 5 percent.

2. Cement and sand shall be mixed in proportions as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement sand shall be first mixed dry in the required proportion to obtain uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has suffered because of evaporation of water the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

4. Bricks shall be soaked in water for a minimum period of one hour before use. When bricks are soaked they shall be removed from the tanks sufficiently in advance so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where

they are not spoilt by dirt, earth etc.

5. All brick work shall be laid in English bond, even and true to line, plumb level and all joints accurately kept. The bricks used on the face shall be selected whole ones of uniform size and with true rectangular face.

5.1 Bricks shall be laid frogs up, if any, on a full bed of mortar. When laying bricks shall be slightly pressed so that the mortar gets into all the surface pores of bricks to ensure proper adhesion. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left.

5.2 Before laying bricks in foundations, a layer of not less than 12 mm. of mortar shall be spread to make the surface on which the work will be laid even.

5.3 The brick work shall be built in uniform layer, corners and other advanced work shall be raked back. Brick work shall be done true to, plumb or in specified manner. No part of it, during construction, shall rise more than one metre above the general construction level to avoid unequal settlement and improper jointing.

5.4 Tothing may be done where future extension is contemplated but shall be used as an alternative to raking back.

5.5 The thickness of joints shall not exceed 12 mm.

6. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good bond with the new work.

7. Green work shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day.

7.1 During hot weather, all finished or partly completed work shall be covered or wetted in such manner as will prevent rapid drying of the brick work.

8. The scaffolding shall be sound and strong to withstand all loads to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs or arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

9. In case of abutment and wing wall, weep holes as shown on the drawing or directed by the Engineer-in-charge shall be provided in the masonry to drain moisture from the backfilling. Weep holes shall be 8 cm. wide, 15 cm. high or circular 15 cm. diameter and shall extend through the full width of the masonry with slope of about 1 vertical to 20 horizontal high or circular of 15 cm. towards the draining face. The spacing of weep holes shall be generally 1 m. in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

10. All brick work shall be measured in cubic metres.

11. The contract unit for brick work shall include the cost of all labour, materials tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above and provision of weep holes.

ITEM-63 : Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per Indian Railway Standard specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slope) of class NP3 of following internal diameters.

(i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia. (vii) 1200 mm dia.

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites.

We have experience of manufacturing of pipes of _____ years

The pipes supplied by us to M/s. _____ satisfy the requirement of IS : 458

Date : _____

Place : _____

Manufacturer's Sign. _____

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform

invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. R. C. C. pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

ITEM-64 : Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and jointing the pipes in C. M. 1:2 watering and laying (to level or slope), of I.S. class of NP2 of following internal diameter. (i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia (vii) 1200 mm dia.

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be of NP2 class instead of NP3 class conforming to requirements of IS : 458 and of the dia as specified in this item.

ITEM-65 : Supplying and fixing NP1 class R.C.C. pipes

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be ordinary irrigation pipes of NP 1 class instead of NP 3 class conforming to requirements of IS:458 and of the dia. as specified in this item. Please see Item No. 78 for detailed information.

ITEM-66 : Filling around the pipes with murrum including dressing, tampering etc. complete.

1. Area around pipes shall be filled with murrum, chhara or other gritty material immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter, and lumps and shall be approved by the Engineer-in-charge. Filling upto 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, tampered or vibrated in layers of not exceeding 150 mm. particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur. In case of high embankments, after filling upto the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted. Materials shall be filled in pharas 3m. x 1.5m x 0.5m size and shall be measured in cubic metres. Unit rate includes cost of materials and spreading including labour and tools needed for the above operations.

ITEM-67 : Providing and laying ordinary (unreinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete including cost of form work (without reinforcement)

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M.100; M.150; M.200 and M.250.

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

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done, proportioning of sand be as per its dry volume. In case it is damp allowance for bulking shall be made as per IS:2386 (Part III).

4. In gredients required for ordinary concrete cotaining one 50 kg.bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of Concrete	Mix by Volume	Total quantity of dry aggregate by volume per 50 kg cement to be taken as sum of individual volume of fine & coarse aggregate maximum (1 cubic metre = 1000 litres)	Proportion of fine aggregate to Coarse aggregate	Quantity of water per 50 kg of cement maximum
1	2	3	4	5
Ordinary M100	1:3:6	300	Generally 1:2 for fine aggregate to coarse aggregate by volume but to a upper limit of 1:1.5 and lower limit of 1:3	34
Ordinary M150	1:2:4	220		32
Ordinary M200	1:1.5:3	160		30
Ordinary M250	1:1:2	100		27

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

Example : For an average grading of fine aggregate (that is Zone II of IS:383 - 1963) the proportions shall be 1:1 1/2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

Note : A mix leaner than M 100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

i Plain C.C.	63 mm
ii Solid type piers, abutments and wing walls, and their per caps. (Coarse aggregate of size upto 40 mm shall be machine crushed.)	40 mm
iii C.C. Wearing Coat M-150 (Coarse aggregate of size upto 40 mm shall be machine crushed.)	20 mm

6. Fine aggregate shall be clean, hard coarse sand. It shall be free from dust and such other substances. The sand shall be got approved by the Engineer-in-charge.

7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work.

8. Cement shall be stored above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that it satisfies the acceptability requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials at edges of the piles.

9. The water for mixing shall be potable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

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

11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement. Then shall be mixed thoroughly by turning over to mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixer shall contain only two third of normal quantity of coarse aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 metres. When tucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and cleaned with a 13mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the new surface with wire or bristle brushed. Care being taken to avoid dislodgement of particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corner and close

spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrator cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipments is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibrations due to traffic, rapid temperature changes, fast drying out process. It shall be covered with wet sacking hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Forms for concrete shall be constructed of metal or timber suitably lined and be of substantial and rigid construction true to shape and dimensions shown on the drawings. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provided a smooth, plain surface. Where timber is used it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the cement surface of concrete. For exposed concrete faces, timber for shuttering shall be wrought on all faces in contact with concrete.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of surface specially in long spans to counteract the effects of any deflection. The frame work shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of form work to avoid sharp corners.

20. The inside surface of forms shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in form work of concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the formwork does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Where applicable arrangements must be made to ensure that the form does not restrain the shortening and hogging of the beams of slabs during tensioning of the tendons. The formwork should take due account of the calculated amount at positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formworks, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete the removal of the load supporting or soffit forms may commence when concrete has attained strength and of the materials used in the ix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the formwork it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement Concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which have been pointed shall be kept moist for a period of 24 hours. If rock, pockets/ honeycombs, in the opinion of the Engineer-in-charge are of such an extent and character as to affect structure materially or to endanger the life of the strength of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected. Joint shall be filled up with bitumen as directed by Engineer-in-charge in case of C.C. wearing surface.

24. The unit rate for concrete shall include the cost of all materials, labour, tools and plants required for mixing, placing in positions, vibrating and compacting, finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown in the drawings and according to these specifications. The rate shall also include the cost of making, fixing and removing of all centering and forms required for the work centering.

25. The payment will be made on cmt. basis of the finished work.

Item No. 68 A : Providing & laying C.C. 1:4:8 (1-Cement, 4-coarse sand, 8-grade agg 40 m.m. nominal size) and curing comp. of form work.

Item No. 68 B : Providing & laying C.C. 1:5:10 (1-Cement, 4-coarse sand, 8-grade agg 40 m.m. nominal size) and curing comp. incl. cost of form work.

Materials : Specification for all the ingredients to be used shall be as per the details given in the central specifications for materials attached.

PROPORTION : The concrete shall consist for the part of cement, sand and metal as per (40 to 63 m.m. size) the above description of items.

MIXING : Mixing of the materials shall be done as for specified volumetric proportion as a possible after water is added, so that every place of agg. is uniformly coated by cement plaster. The concrete must be used immediately after it is prepared and in any case shall be used after the cement has attained final set. Generally concrete prepared before more than half an hour shall not be permitted to be used.

LAYING : Consolidation shall be rapidly carried out sufficient labour being employed to permit of ramming reading be spreading etc. being comp. within as short items as possible causing the mortar to cream up in no case shall ramming be prolonged after the cement has been to take its initial sets.

CURING : As soon as the concrete has set sufficiently i.e. after about an hour of laying the surface must be protected from rapid curing out by being covered with at sand wet sunny of where possible curing shall done by forming the shall be allowed pools of water by means of sand pollics. The curing shall be continued or atleast 10 (ten) days broadly two or three weeks and where possible for longer period. The rate includes all necessary equipments, labour etc. Payment shall be made on cubic measurement of cement concrete. The entire work shall be carried out as per the specification for the PWD Hand book Vol. I Page No. 166 to the satisfaction of the Engineer-in-charge.

ITEM-69 Providing and laying ordinary (reinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete (excluding cost of reinforcement)

1. Para 1 to 25 of ordinary concrete [without reinforcement] shall apply.

26. In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency which must depend upon the nature of work and methods of vibration of concrete, shall be determined by regular slump test. Following test slump shall be adopted for different types of works:

Type of work	Slumps where vibrators are used	Slumps Where vibrators are not used.
(i) Mass concrete in R.C.C. foundation, footings and retaining walls.	10mm to 25 mm	80 mm
(ii) Beams, slabs and column simply reinforced	25 mm to 40 mm	100 mm to 120 mm
(iii) Thin R.C.C. section or sections with congested steel	40 mm to 50 mm	125 mm to 150 mm

Maximum nominal size of the concrete aggregate shall be 20 mm. and shall machine crushed.

Works strength test shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens five of which shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre to concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the 15 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works test shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge, when procedure of test given above reveals a poor quality to concrete and in other special cases.

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

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

30. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Deputy Engineer-in-charge. One carpenter with helper will invariably be kept present through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different part as suitable platforms shall be provided so that steel reinforcement in positions is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concentring of important structural members shall always be done in the presence and under the supervision of department person not below the rank of Junior Engineer/Supervisor/Overseer.

After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete of good quality. Plastering shall not be allowed to the exposed face of concrete.

31. In reinforced concrete, the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

Item No. : 70 Providing T.M.T. & Fixing Bars (Thermo Mechanically Treated Bars of Sail, Tisco, Thermex, Kamdhenu or equivalent brand) reinforcement confirmed to IS-1786 Fe-415 for R.C.C. work including bending, binding and placing in position complete upto floor two level. (B) High yield strength deformed bars reinforcement.

The work include providing and laying in position HYSD / Mild Steel / Thermo mechanically treated bar of the following grade.

Grade Designation	Bar type conforming to Governing IS Specification	Characteristic strength by Mpa	Elastic modulus Gpa
S 415	IS 1786 High yield strength Deformed bar	415	200
S 240	IS 432, Part-II	240	

TMT BAR

415 TMT Bar shall conform to min. 415 Mpa yield strength, Tensile strength of min. 500 Mpa and elongation min. 22. The chemical composition of bars shall be as below :-

	% Max.
Carbon	0.25
Sulphur	0.05
Phosphorus	0.05
Sulphur and Phosphorus	0.01

1. All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work. Only new steel bars shall be delivered to the site. Every bar shall be inspected before assembling in the work and defective brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

2. The work shall consist of furnishing and placing reinforcement of the shape and dimensions shown on the drawings or as directed by the Engineer-in-charge.

3. Steel shall be clean and free from loose rust and loose mill scale at the time of fixing in position and subsequent concreting.

4. Reinforcing steel conform accurately to the dimensions given in the bar bender schedules shown on relevant drawings. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-charge, 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 work, they shall be not heated to facilitate bending. Unless otherwise specified a "U" type hook at the end of each bar shall invariably provided. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be atleast four times the diameter of the round bar. In the case of bar which are not round and in the case of deformed bars, ten 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.

5. All reinforcement bar 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 conforming to I. S. 280 and by using stay blocks or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation on the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports will not extend to the surface of concrete, except as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bar, precast motor blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete all ready placed. To protect reinforcement from corrosion concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

6. Bars crossing each other, where required, shall be secured by binding wire (Annealed) of size not less than 1 mm. and conforming to I. S. 280, in such a manner that they do not slip over each other at the time of fixing and concreting.

7. As far as possible, bars of fully length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-charge. When practicable, overlapping bars shall not touch each other, but be kept a part of 25 mm or 1.25 time the maximum size of the coarse aggregate whichever is greater, by concrete between them. Where not feasible, overlapping bars shall be bound with annealed steel wire, and not less than 1 mm. thickness twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither sphere not bending moment is maximum.

8. Whenever indicated on the drawings or desired by the Engineer-in-charge bar shall be jointed by couplings which shall have a cross section sufficient to transmit the full stresses of bars. The ends of the bars that are jointed by couplings shall be upset for a sufficient length so that effective cross-section at the base of threads is not less than the normal cross-section of the bar. Threads shall be standard white worth threads. Steel for coupling shall conform to IS 226.

9. 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 where steel is not 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 conforms to any other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 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 shall conform to IS 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of tests shall be as directed by the Engineer-in-charge.

10. Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work, where welding or coupling is resorted in place of lap-joints such joints shall be measured for payment as the 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 IS 1732. Length shall include hooks at ends. Wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11. Rate for reinforcement shall include cost of all steel, its carting to work site, cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed by Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of jointing as per approved methods and all wastage, and spacer bars.

12. Payment shall be made on Kg. basis.

Item No. : 71 : Providing & Laying Controlled Cement Concrete M : 150 & Curing Complete (excluding Cost of reinforcement)

Relevant Specification of Item 67 shall be followed except that ingredients of concrete shall be of mix Design.

ITEM-72 : Providing Cement Pointing on uncoursed/coursed stone/brick wall masonry with cement mortar 1:3 (1 cement : 3 sand) (A) Flush Pointing (B) Ruled Pointing

1. For a surface which is to be subsequently jointed, the joints shall be squarely raked out to a depth of 15 mm. while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

2. Cement and sand shall be mixed in proportions as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately by hand-mixing. The operation shall be carried out on a clean watertight platform and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water, the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency but this re-tempering shall be permitted only with thirty minutes from the time of addition of water at the time of initial mixing.

4. For pointing, the mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall then be finished to proper type given on the drawings. If type of pointing after the mortar has been filled and pressed into the joints and finished off level with the edge of the bricks, it shall while still green be ruled along the centre with a half round tool of such width as may be specified by the Engineer-in-charge. The superfluous mortar shall then be cut off from the edges of the lines and the surface of masonry shall also be cleaned of all mortar.

5. Curing shall be started as soon as the mortar used for finishing has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of at least 7 days. During this period it shall be suitably protected from all damage.

6. Stage scaffolding shall be approved for the work. This shall be independent of the structure.

7. The work of pointing shall be measured in square metres of the surface treated.

8. The rate for pointing shall include erecting the removal of scaffolding all labour, materials and equipment incidental to complete the pointing, raking out joints, wetting filling with mortar, troweling, point and watering.

ITEM-73 Providing and laying 22.50 cms. thick rubble stone pitching including preparing surface, laying 15 cms thick murrum layer over prepared surface and arranging rubbles on it by hand packing and in level & lined surface in slope camber including filling the interstices between adjacent stone by spalls of proper size & wedged for right packing as directed etc complete without cement pointing.

1. The work shall consist of covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.

2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.

(G.C.No. SSR/2080 IB 547/28/C, dated 6th March, 1982)

3. Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and uniform slope throughout. Depressions shall be filled and thoroughly compacted.

4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 mm. Quality of murrum will be as per its relevant specifications.

5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimensions is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interspaces between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panels of 3.0 M x 3.0 M with a 30 CM wide and 8 CM. deeper band all around.
6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.

7. The rate shall include the cost of preparing the base, putting to the profiles, providing, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour and materials as well as tools and plant required of the work.

ITEM-74 Providing 12 mm thick premoulded asphalt filler joints as per drawings.

1. Open joints shall be constructed at the location as directed by the Engineer-in-charge using a wood strip metal plate or other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete, at the joints, shall be well finished. Reinforcement shall not extend across an open joint.
2. When preformed filler is to be provided, the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab. Care shall be taken to prevent the former form being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose materials sticking to it.
3. The material used for filling expansion joint shall be bitumen impregnated felt. Impregnated felt shall conform to the requirement of IS:1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.
4. The expansion joint shall be measured in running metres. Thickness of the expansion joint will be 20 to 25 mm. Width of expansion joint shall be equal to full depth of the slab.
5. The rate shall include the cost of all materials, labour, equipments incidental charges for fixing the joints complete in all respects as per these specifications and as shown on the drawings.

ITEM-75 Providing parapet of controlled cement concrete M 150 as per detailed drawing with necessary reinforcement including shuttering laying, vibrating & finishing to line level complete precast consistency.

1. Railings shall not be placed until the centering or false work for the span has been released, and is self supporting. The type of railing to be constructed shall be as shown on the drawing. The railing shall be carefully erected true to the line and grade. Posts shall be vertical with a tolerance not to exceed 6 mm in 3 metres.
2. The portion of the railing or parapet which is to be casting in place shall be constructed in accordance with the relevant specification for reinforced cement concrete. Forms shall either be of single width boards or shall be lined with suitable materials duly approved by the Engineer-in-charge. Form joints in plane surfaces will not be permitted. All mouldings, panels in the finished work shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean cut and shall be free from cracks, spall or other defects.
3. Railing shall be measured in running metres.
4. The rate of railing shall include the cost of all labour, material, tools and plant required, for doing the work complete in all respects in accordance with these specifications, and as shown on the drawing.

ITEM-76 Providing 15 mm thick cement plaster in single coat on brick/Concrete wall for interior plastering up to floor two level finished even and smooth in (i) Cement mortar 1:3 (1 cement :3 sand) (ii) Cement mortar 1:4 (1 cement :4 sand) (iii) Cement mortar 1:6(1 cement :6 sand)

1. For a surface which is to be subsequently plastered the joints shall be squarely racked out to a depth of 15 mm, while the mortar is still green. The racked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.
2. Cement and sand shall be mixed in proportion as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.
3. The mixing shall be done intimately by hand mixing. The operation shall be carried out on a clean watertight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed thoroughly after addition of water. In case of cement mortar that has stiffened because of evaporation of water, the same shall be retempered by adding

water as frequently as needed to restore the requisite consistent but this retamping shall be permitted only within thirty minutes from the time of addition of initial mixing.

4. Plastering shall be started from top and worked down. All pitlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 metres to 4 meters apart to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster float and pressing the mortar to the racked joints are properly filled.

The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideway motion 50 mm or 75 mm at a time. Finally, the surface shall be finished off with a plaster's wooden float. Metal floats shall not be used.

5. When recommencing plastering beyond the work suspended earlier the edge of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas. No portion of the surface shall be left out initially or be patched by later on. The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required by the Engineer-in-charge. The average thickness of plaster shall not be less than the thickness specified in the item with a tolerance of 3 mm thickness which appear in the surface and all portions, which sound hollow when tapped, or are found to be otherwise defective, shall be cut out in rectangular shape and re-done as directed by the Engineer-in-charge.

6. Curing shall be started as soon as the mortar used for finished has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages.

7. Stage scaffolding shall be provided for the work. This shall be independent of the structure.

8. The work of plastering shall be measured in sq. metre of the surface treated.

9. The rate of plastering shall include the cost of all labour, materials tools and plant scaffolding and all incidental expenses as described herein above.

ITEM - 77 White washing :

White washing with lime on wall surface two coat to give an even shade including thoroughly brooming the surface to remove all dirt, and mortar drops and other foreign matter.

1. **General :** Lime shall be hydraulic lime of approved quality.

The slaked lime, if stored, shall be kept in a weather proof and damp roof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any ways shall be rejected and all rejected materials shall be removed from site of work.

2. **Workmanship :** The fat lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 Kg of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be added to each cubic meter of lime cream. Small quantity of ultra marine blue shall also be added to the last two coat of white wash solution and the whole solution shall be stirred thoroughly before use.

3. **Preparation of surface :** The surface shall be thoroughly cleaned of all dust mortar dropping and other foreign matter before white wash is to be applied. Oil or grease spots shall be removed by suitable chemicals and smooth surface shall be rubbed with wire brush.

All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly.

4. **Application of white wash :** On the surface so prepared the white wash shall be applied with brush. The first stroke of the brush shall be from top to downwards and another from bottom to upwards over the first stroke and similarly one stroke from the right and another from the left over the first stroke before it dries.

Each coat shall be allowed to dry before next coat is applied number of coats as specified in item shall be applied.

5. **Mode of Measurement & Payment :** All work shall be measured in the decimal system i.e. in sq. meters. Deduction for pipe openings shall be made fully both sides of openings. The rates shall includes the cost of all materials, labour, scaffolding protective etc. involved in all the operations described. The rate shall be for a unit of one sq. meter.

ITEM-78 (A) Providing & laying C.C. 1:5:10 (1 Cement : 5 Coarse sand : 10 graded stone aggregate of 40 mm nominal size) and curing etc. complete excluding cost of formwork in foundation and plinth.

1.0 Material

1 Water

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalis, salts organic matter and other deleterious material which will either weaken the mortar or concrete or our cause

efflorescence or attack the steel in RCC container for transport, storage and handling of water shall be clean water shall conform to the standards specifications in I.S. 456-1978

1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Compression shall be and means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269-1976. Any indication on unsoundness, change in time of setting by 30 minutes or more of decrease or more than 10 percentage of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly effect the hydration reaction or otherwise interface with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

1.4 Hard and bitter water shall not be used for curing.

1.5 Portable water will generally be found suitable for curing mortar or concrete.

2.0 SAND

2.1 Sand shall be natural sand, clean well graded, hard strong durable and gritty particles free from immure amounts of dust, clay kanker modules, soft or flaky particles shall alkali salts, organic matter, learn mica or other deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand.

2.2 **Course Sand :** The fineness modules of coarse sand sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand shall be as under :-

I.S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	90 to 100
1.18 mm	70 to 100
600 MC	30 to 100
300 MC	85 to 70
150 MC	00 to 50

2.3 Fine Sand

The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under :-

I. S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	100
1.18 mm	75 to 100
600 MC	40 to 85
300 MC	05 to 50
150 MC	00 to 10

3.0 Cement

3.1 Cement shall be ordinary portland slab cement as per I.S. 1975 pr portlar alag cement as per I.S. 455 1976.

4.0 Stone coarse Aggregate for Nominal Mix Concrete :

Coarse aggregate shall be or machine crushed stone of black trap of equivalent and hand, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

4.1 The aggregate shall be generally be cubical in shape unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best blacktrap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement. The concrete shall generally be as per the table given below. However in case of reinforced cement concrete the Minimum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm, less than the cover whichever is smaller.

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40 mm	20 mm	16 mm
80 mm	-	-	-
63 mm	100	-	-
40 mm	85-100	100	-
20 mm	0-20	85-100	100
16 mm	-	-	85-100

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40 mm	20 mm	16 mm
12.5 mm	-	-	-
10 mm	0.5	0.20	0.30
4.75 mm	-	0.5	0.5
2.35 mm	-	-	-

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary containing better density and strength of concrete.

4.3 The grading test shall be taken in the beginning and at the change of source of material. This necessary that indicates in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability. Aggregate shall be stored separately and handled in such a manner as to prevent the intermixing of aggregate if the aggregate are covered with dust, they shall be washed with water to make them clean.

2.00 Workmanship :-

2.1 General :-

2.1.1 Before starting concreting the bed of foundation trenches shall be cleared of all loose materials, level, watered and rammed as directed.

2.2 Proportion of Mix :

2.2.1 The proportion of cement sand and coarse aggregate shall be one part of cement 5 parts of sand and 10 parts of bricks bats aggregate and shall be measured by volume.

2.3 Mixing :-

2.3.1 The concrete shall be mixed in a mechanical mixer at the site of hand mixing may however be allowed for collar quantity work if approved by the Engineer-in-charge when hand mixing is permitted by Engineer-in-charge in case of break down of machineries and in the interest of work it shall be carried out on water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10% more cement extra case. One mixing in mechanical mixer shall be done period of 1.5 to 2 minutes and the quantity of water shall be just sufficient to provide a dense concrete of required workability for the purpose.

2.4 Transporting and Placing the Concrete :-

2.4.1 The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, completed and finished within 30 minutes of mixing with water i.e. before the setting commences.

2.4.2 The concrete shall be laid in layer of 15 cms to 20 cms.

2.5 Compacting

2.5.1 The concrete shall be rammed with heavy iron rammer and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

2.6 Curing :-

2.6.1 After final set the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days the date of placement.

2.7 Mode of Measurements and Payments :

2.7.1 The concrete shall be measured for its length, breadth and depth limiting dimensions to those specified on plan or as directed.

2.7.2 The rate shall be for a unit of one cubic metre.

ITEM 78 (B) : Providing & laying C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bats of 40 to 50 mm. nominal size) & curing complete excluding cost of form work in foundation and plinth.

The specification shall be same as per item No.77 (A) except that coarse aggregate shall be brick bats of 40 mm to 50 mm nominal size instead of graded metal.

ITEM-78(C): Providing & laying C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40 to 63 mm. nominal size) including curing etc. complete excluding cost of form an work in the foundation and plinth.

The specification shall be same as per item No. 77 (A).

ITEM-79 Providing and fixing 4" (100 mm) dia, G.I. water spouts 2'6" long in CM necessary iron grating as per design etc. complete (10 CM dia pipe)

The galvanized water spouts of the size 10 cm dia and the Galvanize iron gritting shall be of the approved quality and type, and shall be first got approved from the Engineer-in-charge before actual use. The G.I. pipe shall be of sufficient length projecting Out beyond the concrete surface for sufficient discharge. Iron grating shall be fixed rigidly into the concrete. The galvanized pipe iron as well as gratings shall be painted with two coats of anticorrosive paint.

The measurement shall be recorded and paid on the basis of each No. of pipe fixed in position.

ITEM-80 Providing and laying weep holes in abutments and returns by jointing A.C. pipe of 100 mm. dia including laying in proper grade and joining etc. complete as per detailed specification.

Weep holes shall be provided in solid plain concrete/reinforced concrete, brick/stone masonry, abutment, wing wall and return walls as shown on the drawing or directed by the Engineer to drive moisture from the back filling. Weep holes shall be provided with 100 mm dia AC pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical:20 horizontal towards the draining face. The spacing of weep holes shall generally be 1 m in either direction or as shown in the drawing with the lowest at about 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

The payment shall be made per number of weep holes provided in structure like abutment and returns, wing walls etc.

Unit rate shall be include cost of all materials, labour and equipment to complete the job.

ITEM-81 Providing and fixing 30 cm x 22 cm x 2.5 cm thick year plate of marble stone set in cm 1:4 including finishing and engraving letters etc complete.

Providing and fixing 30 cms x 22 cms x 2.5 cms No and year plate of marble and of standard lettering with leads or paint including finishing etc. complete.

Marble plate shall be white and of approved quality and shall be 25 mm thick and of standard size as directed by the Engineer-in-charge of the work.

Lettering shall be done by U-shape engraving and shall be filled with black paint of approved quality. Lettering shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant I.S. specification.

Measurement shall be per number of marble plate fixed.

Unit rate includes cost of all material, labour etc. for complete work.

ITEM-82 Numbering the C.D. works with approved paint including all materials for painting etc. complete.

Numbering the C.D. works shall be carried out as per relevant I.R.C. specification. Oil paint of approved quality and make shall be used for the purpose. Numbering shall be very neat and clean Arrow shall be marked on the Head wall in the correct direction of flow of water. Payment shall be made on the number basis. Unit rate includes the cost of all materials, labours for painting & lettering as directed by Engineer-in-charge.

ITEM-83 : Providing & fixing Boundary stone as per I.R.C. type design including painting, carving, lettering etc. complete.
(i) Fixing in earth / Fixing in C.C. 1:5:10

1. Boundary stone shall be of the size 20 x 15 x 75 cms. true to all the faces.
2. Boundary stones shall be neatly finished shall be chisel dressed on all the sides and at top.
3. Boundary stones shall be fixed at the border line of acquired length so that the land width is properly demarcated. The width between boundary stones shall be fixed at a distance of 330 feet (100 m.) a part in the direction of length of the road.
4. The letter B.B. of (Border) as directed by the Engineer-in-charge shall be carved on the face of the boundary stone & letter shall be painted with black Japan.
5. The measurement shall be recorded per No. of boundary stone fixed in position and paid accordingly.

ITEM-84 Providing and fixing junction Board of R.C.C. precast as per standard design of I.R.S. including fixing in C.C. block of 1:4:8 with necessary excavation enamel painting, lettering figures etc. complete.

1. These boards should be fixed at a distance of 120 metre from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.
2. The board will be located in such a way that the edge of the board towards the centre of the road will be at a distance of 4.57 metres from the centre of a National Highway and 3.66 meters from the centre of State Highway or Major District Road.
3. The bottom of the board should be 1 metre above the road surface and the board shall be at right angle to the centre line of the road facing the direction of traffic.
4. The board shall be of the size of 107 c.m. in length and 91 c.m. in height for "T" and "Y" junctions shall be 145 C.M. in length and 91 C.M. in height for cross roads.
5. The board shall be painted by two coats, the Board and posts shall be R.C.C. as shown in the type design.
6. The post shall be fixed in concrete and the projection of this above the road level shall be 45 cm x 45 cm and height of 24 cms. above the road level and the top to be finished in plaster from the height of 15 cm.
7. The size of letter and figures shall be 8 cm. for English and 10 C.M. for devnagri and Gujarati scripts.
8. The post shall be painted in black and white reflective strips 23 cm. in height.
9. The board shall be painted in white with border 2 C.M. wide.
10. On this board tablets shall be painted in yellow with black and the tablets shall have 5 cm. clear distance from the board.
11. Each such tablet shall be 61 cm. in length and 33 C.M. in height, arrow lines indicating the direction of the road at the junctions shall be painted in black and shall have a thickness of C.M. for National Highway and 4 C.M. on a State Highway and a C.M. for a Major district road.
12. All letters and figures shall be painted in black.
13. The work shall be carried out as per design as per the instructions of the Engineer-in-charge. The measurements shall be recorded and paid on number basis for board fixed in position.

ITEM-85 Supplying and fixing rough kota stone 60 to 80 mm size including fixing in line & level etc. complete.

The stone to be used shall be approved quality kota stone. It shall be sound, hard, durable and fairly regular in shape and its thickness of the stone at any place shall not be less by 15% of the thickness specified.

The stone shall be laid in line and level with camber as directed & set properly in sand. The whole work shall be generally carried out to the entire satisfaction of Engineer-in-charge of the work.

The rate shall include the cost of all materials and labour involved in all the operations described above. The kota stone flooring shall be measured in square metre correct to two places of decimal. Length and breadth shall be measured correct to be centimeter & between the finished faces of skirting or Dado and no deduction shall be made for extra paid for any opening in floor of a unit of one Sq. M.

ITEM-86 Providing & laying Kota stone for kerbing on both sides of stone paving Incl. fixing kota stone kerbing in 0.30 Mtrs. depth (Kerbing stone of 60 to 80 MM thick size)... etc. complete.

The stone shall be of approved quality kota stone. Specifications for the materials & laying as per item No. 83 above. The rate shall per unit of one Rmt.

ITEM-87 White stone Bela masonry in C.M. 1:5 including curing etc. complete.

The stone shall be fine dressed chisel draft one incl. the drafts on all beds and joints.

The stone shall be laid in regular course. The height of the course shall be as approved by the Executive Engineer. All the course shall be of same height unless otherwise ordered but no course will be thicker than any course below it. No stone shall be less in breadth than in height and less in length than twice the width.

The stone shall break the joints in each course and to be carried out in cement mortar 1:6 and thickness of the joints shall not be more than 10 mm. The side joints and beds of all stone shall be vertical and horizontal respectively and all stones shall be rough, true and square.

The work shall be measured and paid for cubic measurements of the work carried out as per approved drawing or as directed by the Engineer-in-charge.

SCHEDULE FOR TESTING OF MATERIALS

For ensuring quality control and workmanship, Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below.

The materials shall be a got tested at Government recognised Laboratory, (R & B) or field Laboratory of GERI (R & B) for which 1% of the estimated amount put to Tender shall be recovered from the contractor from the R. A. bills and final bills at the testing charges shall be paid to the GERI by the Government. However if the charges increase over 1% no excess recovery shall be made from the contractor as per resolution of B & C Department dated 10th May, 1985 Vide TNC/1085 (4) a.

Item No. as per schedule "B"	Brief Description of Materials to be tested	Qty. of Materials	Prescription of test which shall be carried out	Frequency @ which test shall be carried out	Total No. of Test to be taken
1	25 to 50 H. B. Metal 40 to 63 H. B. Metal 40 to 50 M. C. Metal 20 to 50 M.C. Metal Kapchi		- Gradation Test - Impact value - Flakiness Index	(1 to 100 Cmt - 1 Test 100 to 500 Cmt - 3 Test 500 to 1500 Cmt - 5 Test 1500 to 5000 Cmt - 7 Test)	
2	Grit		- Stripping Value	— As Above —	
3	Murrum		- P. I. Value	One test per / 50 cmt	
4	Sand Quarry Spall CBR test per work		- Silt Content - Gradation	One test per work One test per 200 cmt.	
5	Asphalt		1 Penetration Test as per IS 1218 2 Ductility Test 3 Specification Gravity Test 4 Softening point Test 5 Viscosity Test	No. of Tanker Test 1 to 10 1 11 to 20 2 21 to 50 3 51 to 100 4 Remaining every 50 tanker 1 As per IS. 1208 As per IS. 1202 As per IS. 1204 As per IS. 1206	
6	Tack coat		- Binder temperature for application. - Rate of spread of binder.	Irregular close in intervals Two tests per day.	
7	Carpet & seal coat mix		- grading - temperature of binder in boiler, aggregates in the dryer and mix at the time of laying and rolling (binder content vide IS 1217) - Rate of Spreaded mix materials.	One Test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to minimum of Two tests per plant per day. One Test for each 100 tons of mix subjects to mini. of Two per day plant Regular control through checks on layer thickness.	
8	Bricks		- Water absorption - Efflorescence - Size - Compressive Strength	1 test per 50,000 Bricks	

Item No. as per schedule "B"	Brief Description of Materials to be tested	Qty. of Materials	Prescription of test which shall be carried out	Frequency @ which test shall be carried out	Total No. of Test to be taken														
9	Cement		<ul style="list-style-type: none">- Consistency- Setting time- Compressive Strength- Fineness- Chemical analysis- Soundness	Upto 50 T 1 test (As per 100 T 2 tests GER 200 T 3 tests Manual 300 T 4 tests 2000 500 T 5 tests 800 T 6 tests 1200 T 7 tests and 8 test for larger consignment															
10	Steel		<ul style="list-style-type: none">- Tensile Strength- Yield Stress- Elongation- Size	1 test / 40 tonnes / per category															
11.	C.C. cube 124		<ul style="list-style-type: none">- Compressive Strength (I.S. 516 - 1959)	<table><tr><th>Qty. C.C.M³</th><th>No. of test</th></tr><tr><td>1 to 5</td><td>- 1 no.</td></tr><tr><td>6 to 15</td><td>- 2 no.</td></tr><tr><td>16 to 30</td><td>- 3 no.</td></tr><tr><td>31 to 50</td><td>- 4 no.</td></tr><tr><td>51 & above</td><td>- 4+1</td></tr><tr><td colspan="2">(For each additional 50 M³ or part thereof).</td></tr></table>	Qty. C.C.M ³	No. of test	1 to 5	- 1 no.	6 to 15	- 2 no.	16 to 30	- 3 no.	31 to 50	- 4 no.	51 & above	- 4+1	(For each additional 50 M ³ or part thereof).		
Qty. C.C.M ³	No. of test																		
1 to 5	- 1 no.																		
6 to 15	- 2 no.																		
16 to 30	- 3 no.																		
31 to 50	- 4 no.																		
51 & above	- 4+1																		
(For each additional 50 M ³ or part thereof).																			

The number of tests will be as per Manual of Quality Control or latest Govt. G.R. / Circulars will be final.

The contractor shall have to pay 1% of the estimate cost put to tender towards all testing of materials & the same shall be deducted from their bills for the works. The testing of various materials shall be carried out in GERI and result received shall be binding to all i.e. the contractor and Govt.

Testing charges of GERI shall be born by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

SIGNATURE OF CONTRACTOR

EXECUTIVE ENGINEER