

Item No. 01 : Providing and laying 50 mm thick Bituminous Macadam with B.T. aggregate as per MORTH specification and using bitumen emulsion RS-1 as per IS 8887: for tack coat @ 2.50 KG. / 10 Sq.m. on B T Surface with mechanical sprayer and Bulk asphalt VG-30 for mixing @ 34.00 KG. / M.T. i.e. 3.40 % of total weight of mix including heating and mixing the aggregate and asphalt in continuous of drum mix plant and hot laid process spreading the same by paver finisher and consolidation with roller as per MORTH specification to achieve desire density, including providing all materials equipments, tools and plants, fire wood, oil, kerosene, labour charges etc. complete using contractor's own machinery drum mix plant and paver finisher etc. complete.

504.1. Scope

The work shall consist of construction, in a single course, of compacted crushed aggregates premixed with a bituminous binder, to serve as base/binder course, laid immediately after mixing, on a base prepared previously in accordance with the requirement of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawing or as directed by the Engineer.

504.2. Materials

504.2.1. Bitumen: The bitumen shall be paving bitumen of suitable viscosity grade **VG-30** as per IS: 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines on selection of the grade of bitumen are given in *Appendix - 4*.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2013

| Characteristics | VG - 10 | VG-20 | VG-30 | VG-40 |
|--|---------|-------|-------|-------|
| Absolute Viscosity 60°C, poises, min | 800 | 1600 | 2400 | 3200 |
| Kinematic Viscosity 135°C CSI, min | 250 | 300 | 350 | 400 |
| Flash point, C, min | 220 | 220 | 220 | 220 |
| Solubility in trichloroethylene, % min | 99.0 | 99.0 | 99.0 | 99.0 |
| Penetration at 25°C | 80-100 | 60-80 | 50-70 | 40-60 |
| Softening point, C min | 40 | 45 | 47 | 50 |
| Test on residue from thin film oven test / RTFOT : | | | | |
| (A) Viscosity ration at 60°C, max | 4.0 | 4.0 | 4.0 | 4.0 |
| (B) Ductility at 25°C, cm, min after thin film over test | 75 | 50 | 40 | 25 |

504.2.2. Aggregates

504.2.2.1. The aggregates shall consist of crushed stone, crushed gravel/single or other stones. They shall be clean, strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as per Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3
PHYSICAL REQUIREMENTS OF AGGREGATES FOR
BITUMINOUS MACADAM

| S. No. | Test | Test Method | Requirement |
|--------|---|---------------------|--------------------------------------|
| 1 | Los Angeles Abrasion Value | IS:2386 (Part - 4) | 40 percent Maximum |
| 2 | Aggregate Impact Value* | -do- | 30 percent Maximum |
| 3 | Flakiness and Elongation Indices (Total) | IS: 2386 (Part - 1) | 30 percent (combined) |
| 4 | Coating and Stripping of Bitumen Aggregate Mixtures | AASHTO T 182 | Minimum retained coating 95 per cent |
| 5 | Soundness: | IS: 2386 (Part - 5) | |
| | (i) Loss with Sodium Sulphate 5 cycles | | 12 percent Maximum |
| | (ii) Loss with Magnesium Sulphate 5 cycles | | 18 per cent Maximum |
| 6 | Water absorption | IS: 2386(Part - 3) | 2 per cent Maximum |

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

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

504.2.2. The aggregate for bituminous macadam shall conform to one of the two grading in Table 500-4, depending on the compacted thickness; the actual grading shall be as specified in the Contract.

504.2.3. Proportioning of materials: The bitumen content for premixing shall be **3.40 percent** by weight of the total mix except when otherwise directed by the Engineer.

TABLE 500 - 4
COMPOSITION OF BITUMINOUS MACADAM

| Mix designation Nominal aggregate size layer thickness | Grading 1 40 mm 80-100 mm | Grading 2 19 mm 50-75 mm |
|--|---|--------------------------------|
| IS Sieve (mm) | Cumulative % by weight of total aggregate passing | |
| 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 | 0-8 |
| Bitumen content, % by weight | 3.1 – 3.4 | 3.40% |
| Bitumen grade | 35 to 90 | VG-30 |

Notes: 1. Appropriate bitumen contents for conditions in cooler areas of India may be up to 0.5% higher subject to the approval of the Engineer.

The maximum compacted thickness of a layer shall be **50 mm**.

The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

504.2.4. Variation in proportioning of material: The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content ± 0.3 per cent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900.

504.3. Construction Operations

504.3.1. Weather and seasonal limitations: The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 10°C or less.

504.3.2. Preparation and transport of mix: Bituminous macadam mix shall be prepared in a drum mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

Drum mix plant shall be of suitable capacity preferably of batch mix type. Total system for crushing of stone aggregates and feeding of aggregate fractions in required proportions to achieve the desired mix, deployed by the Contractor must be capable of meeting the overall Specification requirements under stringent quality control. The plant shall have the following essential features:

A - General

- (a) The plant shall have coordinated set of essential units capable of producing uniform mix as per the job mix formula.
- (b) Cold aggregate feed system with minimum 4 bins having belt conveyor arrangement for initial proportioning of aggregates from each bin in the required quantities.
In order to have free flow of fines from the bin, it is advisable to have vibrator fitted on bin to intermittently shake it.
- (c) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyor for measuring the flow of aggregates.
- (d) Dryer unit with burner capable of heating the aggregate to the required temperature without any visible unburnt fuel or carbon residue on the aggregate and reducing the moisture content of the aggregate to the specified minimum.
- (e) The plant shall be fitted with suitable type of thermometric instruments at appropriate places so as to indicate or record/register the temperature of heated aggregate, bitumen and mix.
- (f) Bitumen supply unit capable of heating, measuring/metering and spraying of bitumen at specified temperature with automatic synchronisation of bitumen and aggregate feed in the required proportion.
- (g) A filler system suitable to receive bagged or bulk supply of filler material and its incorporation to the mix in the correct quantity wherever required.
- (h) A suitable built-in dust control system for the dryer to contain/recycle permissible fines into the mix. It should be capable of preventing the exhaust of fine dust into atmosphere for environmental control wherever so specified by the Engineer.

- (i) The plant should have centralised control panel/cabin capable of presetting, controlling / synchronizing all operations starting from feeding of cold aggregates to the discharge of the drum mix to ensure proper quality of mix. It should have indicators for any malfunctioning in the operation.

Every drum mix plant should be equipped with siren or horn so that the operator may use the same before starting the plant every time in the interest of safety of staff.

B - For Batch Type Plant

- (i) Gradation control unit having minimum four deck vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.
- (ii) Proper arrangement for accurate weighing of each size of hot aggregate from the control panel before mixing.
- (iii) Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

C - For Continuous Type Plant

- (i) Gradation control unit having vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.
- (ii) There should be appropriate arrangement for regulating and volumetric control of the flow of hot aggregate, from each bin to achieve the required proportioning.
- (iii) Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

D - For Drum Mix Plant

- (i) It is a prerequisite that only properly screened and graded materials are fed to the bins. If required, a vibratory screening unit shall be installed at the plant site to ensure the same.
A primary 4-deck vibratory screening unit shall be installed before the multiple bin cold feed system for screening the aggregates and grading the same.
- (ii) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyer for measuring the flow of aggregate.
- (iii) There should be arrangement to measure moisture content of the aggregate(s) so that moisture correction may be applied for working out requirements of binder and filler.

The temperature of binder at the time of mixing shall be in the range of 150⁰C -to 163⁰ C and that of the aggregate in the range of 155⁰C - 163⁰C. provided that the difference in temperature between the binder and aggregate at no time exceeds 14⁰C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly, and the discharge temperature of mix shall be between 130⁰C to 160⁰C.

The mixture shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work until such conditions are corrected.

➤ **SCOPE :**

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

➤ **MATERIALS :**

For scarifying and re-laying the granular surface : The materials used shall be coarse aggregates salvaged from scarification of the existing granular base course supplemented by fresh coarse aggregates and screenings so that aggregates and screening thus supplemented correspond to Clause 404.

For patching potholes and sealing cracks : Where the existing surface to be overlaid is bituminous, any existing potholes and cracks shall be repaired and sealed in accordance with Clauses 3004.2 and 3004.3 or as directed by the Engineer.

For Profile Corrective Course : A profile corrective course for correcting the existing pavement profile shall be laid to varying thickness as shown on the Drawings, or as indicated in the Contract Documents. The profile corrective course shall be laid to tolerances and densities as specified for wearing course if a single layer, or base course, if it is to be covered with a wearing course layer.

Profile corrective course and its application : The type of material for use as a profile corrective course shall be as shown on the drawing or as directed by the Engineer. Where it is to be laid as part of the overlay/strengthening course, the profile corrective course material shall be of the same specification as that of the overlay/strengthening course. However, if provided as a separate layer, it may be of the same specification and details given in the contract drawings.

Surface Levels :

The levels of the sub grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer beyond the tolerances mentioned in Table 900-1.

TABLE 900-1
TOLERANCES IN SURFACE LEVELS

| | | | |
|----|---|---|-------|
| 1. | Sub grade | + | 20 mm |
| | | - | 25 mm |
| 2. | Sub-base + 10 mm | | |
| | (a) Flexible pavement | - | 20 mm |
| | (b) Concrete pavement | + | 6 mm |
| | [Dry clean concrete or Rolled concrete] | - | 10 mm |

| | | | |
|----|--------------------------------------|---|-------|
| 3. | Base - course for flexible pavement | + | 6 mm |
| | (a) Bituminous course | - | 6 mm |
| | (b) Other than bituminous | + | 10 mm |
| | (i) Machine laid | - | 10 mm |
| | (ii) Manually laid | + | 15 mm |
| | | - | 15 mm |
| 4. | Wearing course for flexible pavement | | |
| | (a) Machine laid | + | 6 mm |
| | | - | 6 mm |
| | (b) Manually laid | + | 10 mm |
| | | - | 10 mm |
| 5. | Cement concrete pavement | + | 5 mm |
| | | - | 6 mm |

➤ **TACK COAT :**

Scope :

This work shall consist of the application of a single coat of low velocity 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.

➤ **Materials :**

The binder used for tack coat at the rate of **2.50 kg/10 sq.m.** shall be bitumen emulsion complying with IS:8887 of a type and grade as specified in the Section 500.

Contract or as directed by the Engineer. The use of cut back bitumen as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

➤ **Weather and Seasonal Limitations :**

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

➤ **CONSTRUCTION :**

Equipment : The tack coat distributor shall be self propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate, Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

Preparation of base : The surface on which the 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 Clauses 501 and 902 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

Application of tack coat : The application of tack coat shall be at the rate of **2.50 kg/10 sq.m.** and shall be applied uniformly.

➤ **RATE OF APPLICATION OF TACK COAT :**

The emulsion asphalt IS 8887 at the rate of 2.50 kg per 10 sq.m. shall be used for tack coat 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. Where geosynthetic IS proposed for use, the provisions of Clauses 703.3.2, and 703.4.4 shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

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

➤ **Quality Control Work :**

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

➤ **Specifications :** The rate shall cover the provision of tack coat at 2.50 kg per 10 square meter with the provision that the variation in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

➤ **Preparation and transport of mix :**

Bituminous macadam shall be prepared in a drum mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

The plant shall be drum mix type. The plant shall have coordinated set of essential units capable of producing uniform mix within the job mix formula such as laid down in Appendix 'A'.

(a) In case of drum mix plant, the cold feed system shall have variable speed conveyors/ or other suitable devices for regulating the accurate proportion of aggregate in to an even flood flow automatically from a control operation/Control Cabin.

(b) **Bitumen Control Unit :**

Capable of measuring/metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(c) **Filler System :** A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.

(d) **Dust Control :** A suitable built in Dust Control Equipment for the dryer to contain the exhaust of fine dust in the atmosphere for environmental control wherever so specified by the Engineer.

- (e) Suitable auxiliary Bitumen Boiler of Adequate capacity with self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruments.

The temperature of binder at the time of mixing shall be in range of 150 Degree C to 163 degree and that of the aggregate in the range of 155 degree C - 163 degree C provided that the difference in temperature between the binder and aggregate at no time exceeds 14 Degree C. Rate of **asphalt of VG-30 grade** in mixing is **3.40%** per 1 MT of total mix i.e. **34 kg per 1 MT** of total mix.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130 Degree C to 160 degree C.

The mixture shall be transported from the mixing place to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work unit such conditions are corrected.

➤ **Spreading** : The mix transferred from the tipper at site to the paver shall be spread immediately by means of self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections. The paver finisher shall have the following essential features :

- (a) Loading hoppers and suitable distributing mechanism.
- (b) All drives having hydrostatic drive/control.
- (c) The machine shall have a hydraulically extendable screed the appropriate width requirement.
- (d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting of otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- (e) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) The paver shall be fitted with an electronic sensing device for automatic levelling and profile control within the specified tolerances.
- (g) The screed shall have the internal heating arrangement.
- (h) The paver shall be capable of laying either 2.5 to 4.0 m width or 4.0 to 7.0 m width as stipulated in the Contract.
- (i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation. However, in restricted locations and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 123 degree C to 160 degree C. In multi-layer construction, the longitudinal joint in one layer shall offset that in the layer

below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the centre line of the road. 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. Longitudinal and transverse joints shall be offset by at least 250 mm from those in the lower courses and the joint on the top-most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C before laying of adjacent material.

➤ **Compaction :** After the spreading of mix, rolling shall be done by 80 to 100 kN vibratory roller. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated and uni-directional cambered portions, it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or break-down rolling shall be done with 80-100 kN static weight smooth wheel roller (3 wheels or tandem) as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break-down rolling with vibratory roller of 80 to 100 kN static weight or pneumatic tyred roller of 150 to 250 kN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 MPa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks with 60 - 80 kN tandem roller. During the final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with a 80 to 100 kN static roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 per cent of the average laboratory density (obtained from Marshall specimens compacted as defined in Table 500-10), there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose, nor excessive water poured on the wheels.

Rolling operations shall be completed in every respect before the temperature of the mix falls below 100°C.

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous grout laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of approximate binder before the new mix is placed against it.

➤ **Joints**

Where longitudinal joints are made in pre-mixed bituminous materials, the materials shall be fully compacted and the joint made flush in one of the following ways; only method (iii) shall be used for transverse joints:

- (i) by heating the joints with an approved joint heater when the adjacent width is being laid, but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material, to within the specify range of minimum rolling temperature and maximum temperature at any stage for the material, for a width not less than 75 mm. The Contractor shall have equipments available, for in the event of heater break down, to form joints by method.
- (ii) by using two or more pavers operating in echelon, where this is practicable, and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.
- (iii) by cutting back the exposed joint for a distance equal to the specified layer thickness to a vertical face, discarding all material and coating the vertical face completely with [VG-30 viscosity grade](#) hot bitumen, or cold-applied bitumen or polymer modified adhesive bitumen tape with a minimum thickness of 2 mm, before the adjacent width is laid.

All joints shall, be offset at least 300 mm from parallel joints in the layer beneath or as directed, and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking, which ever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

➤ **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.

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be 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.

➤ **Arrangement for Traffic :**

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

➤ **Passage of Traffic along a part of the Existing Carriageway under improvement :**

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such work shall be carried out, would be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of widening existing two-lane to four-lane the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request of the Contractor work on existing two lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled the debris disposed of and the area cleared as per the direction of the Engineer.

➤ **MEASUREMENTS FOR PAYMENT :**

The payment shall be made on the **tonnage basis (M.T.)** of the weight of mix of aggregates and bitumen. For this purpose, the contractor shall have to install a weight bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty 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 weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

➤ **RATE**

The contract unit rate for the work 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 verge, shoulders and construction of diversions;
- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes;
- (iii) Providing all materials to be incorporated in the work including arrangement for stockyards, all royalties, fees, rents where necessary and all leads and lifts;
- (iv) All labour, tools, equipment, plant including installation of drum mix plant, power supply units and all machineries, incidental to complete the work to the Specifications;
- (v) Carrying out the work in pan widths of the road where directed,
- (vi) Carrying out all tests for control of quality and
- (vii) The rate shall cover the provision of bitumen at **3.40 percent** of weight of total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

Item No. 02 :- Providing and laying 25 mm thick Semi Dense Bituminous Concrete with B.T. aggregate as per MORTH gradation VG-30 for mixing @ 50.00 KG. / M.T. including heating and mixing the aggregate and asphalt by continuous of batch mix plant and hot laid process laying with paver finisher and consolidation with roller as per MORTH specification to achieve desire density, including cost all materials equipments, tools and plants, oil, kerosene, firewood, labour charges etc. complete using contractor's own machineries batch mix plant and paver finisher etc. complete.

501. SEMI-DENSE BITUMINOUS CONCRETE

501.1 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 in thickness**.

501.2. Materials

501.2.1. Bitumen: The bitumen shall be paving bitumen of **viscosity grade VG-30** 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, 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.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2013

| Characteristics | VG - 10 | VG-20 | VG-30 | VG-40 |
|--|----------------|--------------|--------------|--------------|
| Absolute Viscosity 60°C, poises, min | 800 | 1600 | 2400 | 3200 |
| Kinematics Viscosity 135°C CSI, min | 250 | 300 | 350 | 400 |
| Flash point, C, min | 220 | 220 | 220 | 220 |
| Solubility in trichloroethylene, % min | 99.0 | 99.0 | 99.0 | 99.0 |
| Penetration at 25°C | 80-100 | 60-80 | 50-70 | 40-60 |
| Softening point, C min | 40 | 45 | 47 | 50 |
| Test on residue from thin film oven test / RTFOT: | | | | |
| (A) Viscosity ration at 60°C, max | 4.0 | 4.0 | 4.0 | 4.0 |
| (B) Ductility at 25°C, cm, min after thin film over test | 75 | 50 | 40 | 25 |

504.2.2. 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.

504.2.3. 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-I (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-15 for gradings 1 or 2 specified in the Contract.

509.3. 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 SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS

| Property | Test | Specification |
|---------------------|--|------------------------------|
| Cleanliness (dust) | Grain size analysis ¹ | Max 5% passing 0.75 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 |
| | Soundness ⁶ | |
| Durability | Sodium Sulphate | Max 12% |
| | Magnesium Sulphate | Max 18% |
| Water absorption | Water absorption ⁷ | Max 2% |
| Stripping | Coating and stripping of bitumen aggregate mixtures ⁹ | Minimum retained coating 95% |
| Water sensitivity** | Retained tensile strength ⁸ | 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 |
| 9.5 | | 70 - 90 |
| 4.75 | | 35 - 51 |
| 2.36 | | 24 - 39 |
| 1.18 | | 15 - 30 |
| 0.6 | | - |
| 0.3 | | 9 - 19 |
| 0.15 | | - |
| 0.075 | | 3 - 8 |
| Bitumen content % by mass of total mix ² | | Min 4.5 |
| Bitumen grade (pen) | | 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, **VG-30 viscosity 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 500.22.

➤ **TACK COAT :**

Scope :

This work shall consist of the application of a single coat of low velocity 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.

➤ **Materials :**

The binder used for tack coat at the rate of 2.00 kg/10 sq.m. shall be bitumen emulsion complying with IS:8887 of a type and grade as specified in the Section 500.

Contract or as directed by the Engineer. The use of cut back bitumen as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

➤ **Weather and Seasonal Limitations :**

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

➤ **CONSTRUCTION :**

Equipment : The tack coat distributor shall be self propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate, Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

Preparation of base : The surface on which the 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 Clauses 501 and 902 as appropriate. Immediately before the application

of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

Application of tack coat : The application of tack coat shall be at the rate of 2.00 kg/10 sq.m. and shall be applied uniformly.

➤ **RATE OF APPLICATION OF TACK COAT :**

The emulsion asphalt IS 8887 at the rate of 2.00 kg per 10 sq.m. shall be used for tack coat 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. Where geosynthetic IS proposed for use, the provisions of Clauses 703.3.2, and 703.4.4 shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

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

➤ **Quality Control Work :**

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

➤ **Specifications :** The rate shall cover the provision of tack coat at 0.20 kg per square meter with the provision that the variation in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

508.4.6 Mixing and transportation of the mixture - The provisions as specified in Clauses 500.1.3 and 500.1.4 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 500.1.6 and 500.1.7 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.

509.5. 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.

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. Arrangement 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 measures for finished work on weight base in **Metric Tonne**.

509.9. Rate

The contract unit rate shall be as specified in Clause 507.9, except that the rate shall include the provision of bitumen **5.0 percent**, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted accordingly, only if the mix design is less than 5.00 percent. If the bitumen content in mix design is more than 5% the difference will be paid only upto 5.00 percent.

Item No. 03 : Providing and laying 100 mm thick specified quarry spall in side shoulders including carriage of materials spreading in live and level and consolidation.

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 site.
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.

Grading for quarry spauls

| IS:Sieve | Grading - I | Grading - II | Grading - III |
|----------|-------------|--------------|---------------|
| 75mm | 100 | - | - |
| 53mm | - | 100 | - |
| 26.5mm | 55-75 | 50-80 | 100 |
| 9.50 mm | - | - | - |
| 4.75mm | 10-30 | 15-35 | 25-45 |
| 2.36mm | - | - | - |
| 0.425mm | - | - | - |
| 0.075mm | < 10 | < 10 | < 10 |

Material passing through 425 micro sieve for all the three gradings when tested according to I.S. 2720 (Part-5) shall have liquid limit and plastic index not more than 25 and 6 respectively.

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. 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.
7. The rate includes blasting the rock, if any, breaking the quarry spauls, stacking measuring in pharas etc. complete.
8. 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.
9. 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 halt kilometer or Km. has been fully collected. Any fraction of these distance shall not be measured up.
10. The measurements shall be recorded in on Cum. basis on level computing method after

rolling and consolidation and shall be paid accordingly.

- **Spreading quarry spauls in grade & camber complete.**

1. The quarry spauls shall be 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 than be filled in basket & conveyed where required and spread evenly on the prepared surface be 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 0:1 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/oiling 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 off templates of while the necessary of the in between shall 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 carnber 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 they equal to the width be laid with over metal Similarly.
12. The Q. S. shall be laid as close as possible so as too leave minimum possible interstices and voids.
13. Before roiling is allowed on soling the side berms shall be filled upto the top of the soling and at least 3'-0" (1 m.) on either side so as to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.
14. Immediately following the spreading of the coarse aggregates rolling shall be started with three wheeled power roller of 8 - to - 10 tone capacity or tendum 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.

15. Except on super elevated portions where the roiling shall proceed from inner edge to outer, rolling shall 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 inward parallel to centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.
16. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate a head of the roller is no longer visible. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall no 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.
17. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re - rolling until the entire surface conform to desired camber and grade. In no case shall the base of screening be permitted to make up depression.
18. The blindage material where it is required to be used shall be applied successively in two or more thin layer 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 the wheels of the rollers, if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids forms a wave ahead of the wheels of the moving roller.
19. After the final compaction of water bound macadam course, the road shall be allowed to any over night 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.

➤ **Mode of Measurement & Payment**

1. Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on **cubic meter** basis.
2. The rate includes the cost of screening the Q.S. if any spreading, sectioning, with template and adding reserved quota of metal, while/oiling is in progress for making good hollows and camber.

408. SHOULDERS, ISLANDS AND MEDIAN

408.1. Scope

The work shall consist of constructing shoulder (hard/paved/earthen with brick or stone block edging) on either side of the pavement, median in the road dividing the carriageway into separate lanes and islands for channelising the traffic at junctions 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.

408.2. Materials

Shoulder on either side of the road may be of selected earth/ granular material/ paved conforming to the requirements of Clause 305/401 and the median may be of selected earth conforming to the requirements of Clause 305.

Median/Traffic islands shall be raised and kerbed at the perimeter and the enclosed area filled with earth and suitably covered with grass turf/shrubs as per Clause 307 and/or paved as per Clause 410.3.4 or 410.3.5.

Paved shoulders shall consist of sub-base, base and surfacing courses, as shown in the drawings and materials for the same shall conform to relevant Specifications of the corresponding items. Where paved or hard shoulders are not provided, the pavement shall be provided with brick/stone block edgings as shown in the drawings. The bricks shall conform to Clause 1003 of these Specifications. Stone blocks shall conform to Clause 1004 of these Specifications and shall be of size 225 mm x 110 mm x 75 mm.

408.3. Size of Shoulders/Median/Islands

Shoulder (earthen/hard/paved) / median / traffic island dimensions shall be as shown on the drawings or as directed by the Engineer.

408.4. Construction Operations

408.4.1. Shoulder : The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up.

Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of earth shoulder layer. The adjacent layers having same material shall be laid and compacted together.

In all cases where paved shoulders have to be provided along Side of existing carriageway, the existing shoulders shall be excavated in full width and to the required depth as per Clause 301.3.7. Under no circumstances, box cutting shall be done for construction of shoulders.

Compaction requirement of earthen shoulder shall be as per Table 300-2. In the case of bituminous courses, work on shoulder (earthen/ hard/paved) shall start only after the pavement course has been laid and compacted.

During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned.

408.4.2. Median and Islands

Median and Islands shall be constructed in a manner similar to shoulder up to the road level. Thereafter the median and islands, if raised, shall be raised at least 300 mm by using kerb stones of approved material and dimensions and suitably finished and painted as directed by the Engineer. If not raised, the median and islands shall be differentiated from the shoulder/ pavement as the case may be, as directed by the Engineer. The confined area of the median and islands shall be filled with local earth or granular material or any other approved material and compacted by plate compactor/power rammer. The confined area after filling with earth shall be turfed with grass or planted with shrubs, or finished with tiles/slabs as provided in the drawings.

408.4.3. Brick/stone block edging: The bricks/stone blocks shall be laid on edge, with the length parallel to the transverse direction of the road. They shall be laid on a bed of 25 mm sand, set carefully rolled into position by a light roller and made flush with the finished level of the pavement.

408.5. Surface Finish and Quality Control of Works

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.

408.6. Measurements for Payment

Shoulder (earthen/hard/paved), island and median construction shall be measured as finished work in position as below :

- (i) For excavation in cu. m.
- (ii) For earthwork/granular fill in cu. m.
- (iii) For sub-base, base, surfacing courses in units as for respective items.
- (iv) For kerb in running metres, length of kerb for median shall be measured for each side separately.
- (v) For turfing, shrubs and tile/slab finish in sq.m.
- (vi) For brick/stone block edging in running meter, the length for brick / stone block edging for median edging shall be measured for each side separately.

408.7. Rate

The Contract unit rate for shoulder (hard/paved/earthen with brick or stone block edging), island and median construction shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) as applicable. The rate for brick/stone block edging shall include the cost of sand cushion.

Item No. 05 : Place identification sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 150 x 90cms. rectangle as 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 nos) 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 bands. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

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 reflective over its entire surface. It shall be weather resistance and show colour fastness. It shall be new and unused and shall shown 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 manufacture of the sheeting. The reflective sheeting shall be either or Engineering Grade material with enclosed lens or of high intensity grade with encapsulated lens/ micro prismatic type. 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 sheetting 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 800-1.

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 10 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 | 15 | 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 reflective.

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 801.3.2 of 801.3.3 as applicable) 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 to a smooth clean surface, or a tack adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The sheeting 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. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

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.

Alternatively, the aluminium blank shall be recycled to a finished condition and new sheeting's put on in an approved manner.

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. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

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. Sheeting 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 butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

1.1.10 **Warranty Durability :** For each lot of sheetings procured, the contractor shall obtain from the manufacturer a 10 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 10 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. The contractor / supplier shall also furnish a certification that the signs and materials supplied against the assigned work meet all the stipulated requirements and carry the stipulated warranty.

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. Direction and place identification signs, also shall be measured in numbers of different type of sign supplied and fixed.

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.

➤ SPECIAL TERMS AND CONDITIONS OF CONTRACT FOR SIGN BOARDS

- 1 Warranty certificate for **10 years** for respective grades of signs from the sheeting manufacturer should be attached with the bid.
- 2 A certificate of authorization from the sheeting manufacturer shall be submitted with the bid.
- 3 The responsibility for handling, upkeep and safety of the boards lies with the contractor until the completion of work and final payment are released.
- 4 The contract is valid for three months from the date of work order. The required quantity has to be supplied and fixed as and when intimated by the Division.
- 5 The measurement for payment will be done only after fulfilling condition up to the satisfaction of Executive Engineer. The 100% quantity of supply and fixing will be checked by Deputy Executive Engineer and at least 10% quantity of supply and fixing will be checked by the Executive Engineer to ensure quality and workmanship, before passing for payments.
- 6 The contractor will have to ensure how he is going to arrange repair or replacement of defective boards after intimation from the Division.

Item No. 05 : Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35- 2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinet on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/ lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 General

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

803.4.1.2 Requirements :

- I. 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 800-9.

Table 800-9 : 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 I nert Fillers | 42.0max. | See Note Below |
| Yellow pigments | — | See Note Below |

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

- II. Properties: The properties of thermoplastic material, when tested in accordance with ASTM 036/BS-3262-(Part I), shall be as below:
 - a. Luminance:
White: Daylight luminance at 45°-65 percent min. as per AASHTO M249
Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M249
 - b. Drying time: When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.
 - c. Skid resistance: not less than 45 as per BS:6044.
 - d. Cracking resistance at low temperature: The material shall show · no cracks on application to concrete blocks.
 - e. Softening point: 102.5°C ± 9.5°C as per ASTM D 36.

- f. Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M 249
- III. Storage life : The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/ Contractor.
- IV. Reflectorisation : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.
- V. Marking: Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
- 1) The name, trade mark or other means of identification of manufacturer
 - 2) Batch number
 - 3) Date of manufacture
 - 4) Colour (white or yellow)
 - 5) Maximum application temperature and maximum safe heating temperature.
- VI. Sampling and Testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.2 Reflectorizing Glass Beads

803.4.2.1 General

This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

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

These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specific Requirements

- a) Gradation: The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

TABLE 800-10: 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 |

- b) **Roundness** : The glass beads shall have a minimum of 70 percent true spires.
- c) **Refractive index** : The glass beads shall have a minimum refractive index of 1.50.
- d) **Free flowing properties** : The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paints striping. They shall pass the free flow test.

803.4.2.4 Test Methods

The specific requirements shall be tested with the following methods:

- i. Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter dessicator which is filled within 25 mm of the top of a dessicator plate with sulphuric acid water solution (specific gravity 1.10). Cover the dessicator and let it stand for 4 hours at 20°C to 29°C. Remove sample from dessicator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be free of lumps and clusters and shall flow freely through the funnel.
- ii. The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS:6088 and BS:3262 (Part I).
- iii. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1 The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.3.2 The material upon heating to application temperatures shall not exude fumes which are toxic, obnoxious or injurious to persons or property.

803.4.4 Preparation

- i. The material shall be melted in accordance with the manufacturer's instructions in a heater with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- ii. After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

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 803.4.2.

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

803.6.3 The thermoplastic material 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.

803.6.4 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. 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. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.5 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).

803.6.6 The markings shall be done to accuracy within the tolerances given below:

- i. Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- ii. The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- iii. The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- iv. The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the Painted sections shall remain the same.

803.6.7 Properties of Finished Road Markings

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

- a. The stripe shall not be slippery when wet.
- b. The marking shall not lift from the pavement in freezing weather.
- c. After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures upto 60°C.
- d. The marking shall not deteriorate by contact with sodium chloride calcium chloride or oil dripping from traffic.
- e. The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- f. The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164

803.6.8 Measurements for Payment

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

803.6.8.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.6.9 Rate

The Contract unit rate for road markings shall be payment in full compensation for 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 all other incidental costs necessary to complete the work.

1.7 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, four years guarantee for durability and reflectivity as per M.O.R.T.H. specification for road and bridge works clause 803 should be given by the bidder in the writing.
- (3) Guarantee security deposit shall be retained @ 10% 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.R.T.H. specification for road and bridge works clause 803.3.2.2 (vi) should be furnished of reputed laboratory before.

Item No. 06 : Dismantling tiled of stone floors laid in mortar including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift.

1.0. Workmanship

- 1.1. The dismantling tiled of stone floors laid in mortar shall consist of dismantling of one or more parts of the building as specified or shown in the drawings. Dismantling 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 dismantling tiled of stone floors laid in mortar 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. Dismantling implies carefully taking up or down or removing without damage. The articles shall be passed by hand where necessary and lowered and where these are fixed by nail, screws, bolts etc., these shall be taken out with proper tools.

2.0. Mode of measurements and payment

- 2.1.** Measurements of all work except hidden work shall be taken before dismantling tiled of stone floors laid in mortar and no allowance for increase in bulk shall be allowed. The dismantling tiled of stone floors laid in mortar 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.
- The rate shall include staking the unserviceable materials as directed with all lead and lift.
- 2.2.** The Rate shall be for a unit of **Sqm.**

Item No. 07 : Demolition of Brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift.(ii) In Cement Mortar.

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 here in after : (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.
- 2.4. The unserviceable materials shall be stacked as directed by Engineer-in-charge with all leads and lifts.

- 2.5.** 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.
- 2.6.** The rate shall be for a unit of one **Cubic meter (Cum)**.

Item No. 08 :- Providing and laying cement concrete 1:4:8 (1- Cement : 4- coarse sand : 8- hand broken stone aggregates 40 mm nominal size) and curing complete excluding cost of formwork in (A) Foundation and Plinth.

1.0. Materials

- 1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Hand broken stone aggregate 40 mm. nominal size shall conform to M-12.

2.0. Workmanship

2.1. General

- 2.1.1. Before stating concrete the bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed

2.2. Proportion of Mix:

- 2.2.1. The proportion of cement, sand and stone aggregate shall be one part of cement. 4 parts of coarse sand and 8 parts of **hand broken** stone aggregates 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 work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on a 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 case 10% more cement than otherwise period 1 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

2.4. Transporting & Placing the Concrete:

- 2.4.1. The concrete shall be handed 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, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.
- 2.4.2. The concrete shall be laid in layers of 15 cms. to 20 cms.
- 2.5.1. The concrete shall be rammed with heavy iron rammers 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 the final set, the concrete shall be kept continuously wet if required by pounding for a period of not less than 7 days from the date of placement.

3.0. Mode of measurement and payment

- 3.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plans or as directed
- 3.2. The rate shall be for a unit of **one Cubic Meter (CuM)**.

Item No. 09 :- Providing and fixing pre-cast Rubber Dye / steel Dye inter locking concrete block 60mm thick with grade of concrete M300 pneumatic compressed / vibrated mechanically and as per approved design Confirming to IS 15658 : 2006 including 35 mm Sand layer for levelling and filling the joint with sand in proper line and level as per guidelines of IRC : SP 63-2018 etc. Complete.

General

This work shall consist of providing and laying precast Rubber dye / steel dye inter locking concrete block 60 mm thick with grade of concrete M-300 as per approved design over a base layer of 35 mm thick layer of sand of the shape and dimensions shown on the drawings and conforming to these specifications or as approved by the Engineer in charge.

1.0 MATERIAL

Water shall conform to M-1. Cement shall conform to M-3.

1.0 Precast Rubber dye / steel dye inter locking concrete block

Precast Rubber dye / steel dye inter locking concrete block shall be of approved size brand and make as approved by Engineer in charge.

- 1.1 The size shape and design of precast Rubber dye / steel dye inter locking concrete block shall generally be as per manufacturers product or as directed by the Engineer in charge and Architect.
- 1.2 The precast Rubber dye / steel dye inter locking concrete block shall satisfy the tests as regards compress strength transverse strength resistance to wear and water absorption.
- 1.3 The colour size shape and design of the precast Rubber dye / steel dye inter locking concrete block shall be directed by Engineer or Architect.
- 1.4 The precast rubber dye / steel dye inter locking concrete block shall be of best quality as approved by the Engineer In charge. They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

2.0 SAND

- 2.1 Sand shall be natural sand, clean well graded, hard strong durable and gritty particular free from immures amounts of dust, clay, kankar modules.
- 2.2. For masonry works sand shall confirm to the requirements of IS: 2116.
- 2.3. For plain and reinforced cement concrete (PCC and RCC) or pre stressed concrete (PSC) works fine aggregates shall consist of clean, hard strong and durable prices of crushed stone, crushed gravel or suitable combination of natural sand crushed stone or gravel, They shall not contain dust lumps soft or flaky materials mica or other deleterious materials in such quantities as to reduce the strength and durability of concrete, or to attack the embedded steel. Motorized sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS L 383 and tests for conformity shall be carried out as per IS : 2386 (Part I to VIII) The contractor shall submit to the Engineer in charge the entire information indicated in Appendix A of IS : 383. The fineness modulus of fine aggregate shall neither be less than 2.00 nor greater than 3.5.
- 2.4. Sand fine aggregates for structural concrete shall conform to the following grading requirements as shown in the table below.
- 2.5 **Fine Sand:** The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under:

| IS. Sieve Designation | % by wt. passing | | |
|-----------------------|------------------|---------|----------|
| | Zone I | Zone II | Zone III |
| 10 mm | 100 | 100 | 100 |
| 4.75 mm | 90-100 | 90-100 | 90-100 |
| 2.3 6mm | 60-95 | 75-100 | 85-100 |
| 1.18 mm | 30-70 | 55-90 | 75-100 |
| 600 MC | 15-34 | 35-59 | 60-79 |
| 300 MC | 5-20 | 8-30 | 12-40 |
| 150 MC | 0-10 | 0-10 | 0-10 |

- **Coarse Sand:** The fineness modules of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand be as under:

| I. S. Sieve Designation | % by wt. passing |
|-------------------------|------------------|
| 4.75 mm | 100 |
| 2.36mm | 90 to 100 |
| 1.18 mm | 70 to 100 |
| 600 MC | 30 to 100 |
| 300 MC | 85 to 70 |
| 150 MC | 00 to 50 |

3.0 WORKMANSHIP

- 3.1** The **precast Rubber dye / steel dye inter locking concrete block** shall be laid on a layer **35 mm thick** layer of coarse sand. The slope in the floors shall be provided in the sub grade. The base layer shall be properly watered, rammed and consolidated. Before laying the pavers blocks, it shall be moisture. Plinth masonry offset shall be depressed so as to allow the sub grade concrete to rest on it.
- 3.2** **Precast Rubber dye / steel dye inter locking concrete block** of approved quality shape and design and shall be laid evenly to level and slope as directed by Engineer in charge over a bed of a base layer consisting of **35mm thick sand layer**.
- 3.3** **Laying:** The **precast Rubber dye / steel dye inter locking concrete block** shall be laid in plain, diagonal or other pattern as directed. The cement concrete blocks shall be laid properly and set home by gentle taping.
- 3.4** **End portion of pavement shall be finished with C.M. 1:3 as per detailed drawing etc. complete.**

4.0 MODE OF MEASUREMENT AND PAYMENT

- 4.1** The unit rate **precast Rubber dye / steel dye inter locking concrete block** flooring shall include the cost of all materials, tools and plant required for supplying and laying material like brick bats sand pavers blocks, laying of base layer in true level and slope as required applying & placing pavers blocks in position, compacting, finishing, curing.
- 4.2** The length and breadth shall be measured correct to a Square meter correct to 2 places of decimal. Length and breadth shall be measured to correct to a centimeter and between the finished the finished face of the skirting, dedo or wall plaster and no deduction shall be made nor extra paid for any opening in floors or areas up to 0.1 square meter.
- 4.3** The rate shall be for a unit of **one Square meter**.

Item No. 10 :- Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30cm length, 30cm height and 15cm thick of M 250 grade concrete as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand) etc complete.

The item shall be carried out for precast concrete kerb stone of grey cement based concrete block 30 cm length, 30 cm height and 15 cm thick of M-250 grade concrete as per approved design and as per the direction of Engineer in charge.

| | | |
|------------------------|---|----------------|
| <u>Filter Material</u> | : | Kapachi : M-13 |
| | | Sand : M-6 |

The item shall be carried out as per the direction of Engineer in charge.

MODE OF MEASUREMENT & PAYMENT

The Rate and Mode of measurement shall be as per completed item including all labour & materials involved to execute this item as per **Rmt.** basis.

Contract rate shall be for a unit of one Rmt. basis.

Item No. 11 :- Steel work, welded in built up sections framed work including cutting, hoisting, fixing in position and applying a priming coat of red lead paint. (A)In beams and joists, channels angles Tees, flats, with connecting plates or angle cleats as in main and cross beams.Hip and jack rafters, purlins conneted to common rafters and the like.

1.0. Materials

The structured steel work shall conform to M-22. Red lead paint shall conform to I.S : 102-1962.

2.0. Workmanship

2.1. Welding shall generally be done by electric process. Gas welding shall be resorted to, using oxyacetylene flame with specific prior approval. Gas welding shall not be permitted for structural steel work.

2.2. The work shall be done as shown in the shop drawings which should clearly indicate various details of the joints to be welded, shop and site welded as well as type of electrodes to be used, symbol for welding on plans and shop drawings shall be according to I.S. 813-1961. As far as possible every effort shall be made to limit the welding that must be done after improper welding that is likely to be done due to heights and difficult positions on scaffoldings etc. The welding work shall conform to I.S. 816-1969.

2.3. Preparation of surfaces : Surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

2.4. Assembly for welding : Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the plates accurately in place without displacement.

2.5. Precautions : All operations connected with welding and cutting equipment shall conform to safety requirement given in I.S. 818-1968.

The following points shall be borne in mind during the process of welding:

(b) Arc length voltage and amperage shall be suited to the thickness of material type of groove and other circumstances of the work.

(c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

2.6. The defective welds which shall be considered harmful to the structural strength shall cut out and reworked.

2.7. Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed. Welds and adjacent parts shall be painted after the same are approved.

2.8. All the members shall be thoroughly cleaned of rust-scales, dust etc. and given a priming coat of red lead paint before fixing them in position.

Testing of welding to be added in the specification I.N. 12.2.2.12-(i) to (viii).

3.0 Mode of measurements & payment

3.1. The steel work shall be measured in general as under:

- (a) All work shall be measured on the basis of finished dimensions as fixed at site and measured net unless specified otherwise.
- (b) The weight of steel sections, steel rods, and steel strips in finished work shall be calculated on standard weight on the same basis on which steel is supplied to Contractor by department or those given in relevant I.S. if steel is arranged by the contractor.
- (c) The weight of steel plates and strips shall be taken from relevant I.S. based on 7.35 kg./sq. meter for every millimeter sheet thickness if steel is supplied to the contractor by department.
- (d) Unless otherwise specified, weight of cleats, brackets, packing pieces, bolts, nuts, washer, distance pieces, separators, diaphragm gusset (taking overall square dimensions) fish plates etc. shall be added to the weight of respective items.
- (e) In riveted work allowance is to be made for weight of rivet heads. No deductions shall be made for rivet or bolts holes excluding holes for anchor or holding down bolts.
- (f) For forged steel and steel castings, weight shall be calculated on the basis of 7850 kg./cum.
- (g) Unless otherwise specified, no allowance shall be made for the weld metal in case of welded steel structure.
- (h) Dimensions other than cross sections and thickness of plates shall be measured to nearest 0.001m
- (i) Mill tolerance shall be ignored when weight is determined by calculation.

3.2. The rate includes cost of all material, labour, erection, hoisting scaffolding, protective measures, required for proper completion of the item of work. This shall also include conveyance and delivery handling, loading, unloading and storing etc. required for completing the item described above including necessary wastage involved.

3.3. The rate shall be for a unit of per **Quint**.

Item No. 12 :- Providing corrugated G.I. sheet of class-3 roofing fixed with galvanized iron J or L Hooks, Bolts and nuts 8mm diameter with bitumen and G.I. limpet washer or G.I. limpet washer. filled with white lead complete excluding the cost of purlins, Rafters and Trusses.(1) 0.80 mm thick sheet.

1.0. Materials :

1.1. Corrugated G.I. sheet shall conform to M-23.

2.0. Workmanship

2.1. **Spacing of purlins :** One purlin shall be provided at the ridge and one at the eaves. The spacing of other purlins for 0.80 mm. thick G.I. sheet shall not exceed 1.80 meters. The purlin shall coincide with the centre line of the end lap. The ridge purlins shall be placed in such a way that the ridges can be fixed properly. The portion overhanging the wall support shall not be more than one fourth of the spacing of purlins.

2.2. The top surfaces of the purlins shall be painted before the sheets are fixed over them. Embedded portions of purlins shall be finished with two coats of coal-tar.

2.3. Laying of Sheets

2.3.1 The sheets shall be laid in purlins to a true plane with the line of corrugations truly parallel or normal to the sides of area to be covered. The sheets shall not generally be built into gables and parapets. They shall be bent up along their side edges close to the wall, and the junction shall be protected by suitable flashing or by projecting drip course.

2.3.2 The laps at end shall be provided 150 mm. minimum for roof slopes 1 in 2 (1 vertical : two horizontal) and steeper but 200 mm. shall be provided for flatter slopes than those above. The side lap shall be provided two ridges of corrugations at each side.

2.3.3. The sheets shall be cut to the dimensions or the shape of the roof either along their lengths or their width or in slant across the line of corrugations at hips and valleys. The sheets shall be cut carefully with a straight edge and chisel to give straight finish. The sheets shall be laid such that the laps are turned away from the usual direction of local heavy rain.

2.3.4 Fixing of Sheets :

2.3.4.1 Sheets shall be fixed to the purlins or other roof members such as hips or valley rafter etc. with 'J' or 'L' galvanized hook bolts, and galvanized nuts 8 mm. dia. with bitumen limpet washers and G.I. washers. Limpet washers with white lead shall be used. Length of hook bolt shall be varied to suit the site requirement. Bolts shall be sufficiently long so that after fixing the project above the top of their nuts by not less than 12 mm the grip of 'J' or 'L' hook bolts on the sides of purlins shall not be less than 25 mm. There shall be minimum of three hook bolts placed at the ridge of corrugations in each sheet in every purlin and their spacing shall not exceed 300 mm. Coach screw shall not be used for fixing the sheets to purlin, where the slopes of roof are not less than 2 1/2 degree (1 vertical and 2 1/2 horizontal). Sheets shall be jointed together at the side laps by galvanized iron bolts and nuts 25 mm. x 6 mm. size each bolt with a bitumen and G.I.

limpet washer filled with white lead. Where the overlaps at the sides extend to two corrugations, these bolts shall be placed zigzag over lapping corrugations, so that the ends of the overlapping sheets are drawn tightly towards each other. The spacing of same bolts shall not exceed 600 mm. along each of the staggered rows.

- 2.3.5.** Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the under side, while the sheets are on the ground. The holes in the sheets shall be at least 50 mm. from the edge. Sheets drilled wrongly shall be rejected. The holes in the washers shall be of the exact diameter of the hook bolts or the beam bolts. The nuts shall be tightened from above to give a leak-proof root.

3.0. Mode of measurements and payment

- 3.1.** The measurements of the G.I. sheet shall be taken for finished work in superficial area in general plane (not girthed on the roof). The laps between the G.I. sheet both at their ends and along the side edges shall not be measured. The overlaps of G.I. sheet over the valley piece and their under lap under the ridge, hip and flashing piece shall be included in the measurements.
- 3.2** No deductions in measurements shall be made for openings for chimney stacks, sky light etc. of area up to 0.40 sq. mt. nor extra be paid for labour in cutting and for wastage etc. in forming such openings.
- 3.3.** The rate of roof shall include the cost of all materials and labour involved in all operations described above. The rate also includes the cost of provision, erection and removal of the scaffolding, benching, ladders, templates and tools required for the proper execution and erection of the work. The rate includes the cost of purlins, rafters and trusses.
- 3.4.** The rate shall be for a unit of one Sq. meter (**Smt**).