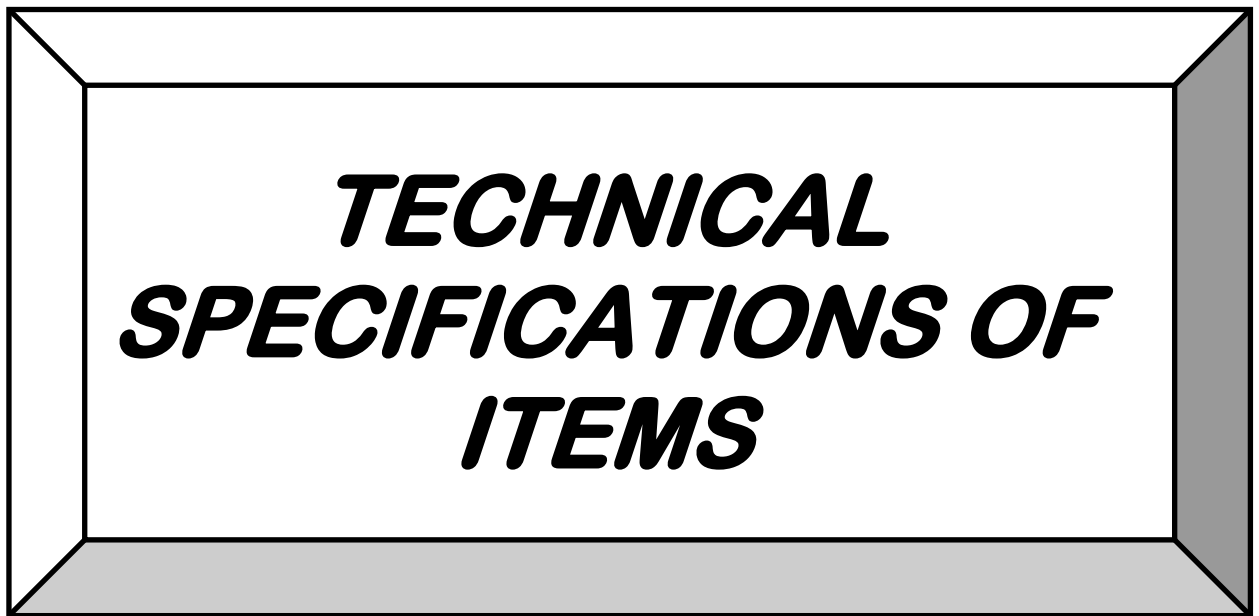


**Name of work : - Improvement of Various roads of Lalpur Taluka
Under Kishan path Yojana Package No.
JAM/KP/ 2023-24 /P-15**

Taluka: Lalpur

Dist: Jamnagar.



**Name of work : - Improvement of Various roads of Lalpur Taluka
Under Kishan path Yojana Package No.
JAM/KP/ 2023-24 /P-15**

Taluka: Lalpur

Dist: Jamnagar.

TECHNICAL SPECIFICATIONS OF ITEMS

- Item No.1 Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials (C) By mechanical means in area of light jungle**

201. CLEARING AND GRUBING

201.1. Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil etc. to an average depth of 150mm in thickness, which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials with all lead and lift. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these specifications.

201.2. Preservation of Property/Amenities

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

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306 (as per Page No. 77 in MORTH specification booklet). Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc. and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3 (as per Page No. 78 in MORTH specification booklet).

201.3. Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer and which will not affect any property to be preserved shall be adopted for the work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

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

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

201.4. Disposal of Materials

All materials arising from clearing and grubbing operations shall be taken over and shall be disposed of by the Contractor at suitable disposal sites with all lead

and lift. The disposal shall be in accordance with local, State and Central regulations.

201.5. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of **Hectares**. Cutting of trees upto 300mm in girth and removal of their stumps, including removal of stumps upto 300mm in girth left over after trees have been cut by any other agency and trimming of branches of trees extending above the roadway and back filling to the required compaction shall be considered incidental to the clearing and grubbing operations. Clearing and grubbing of borrow areas shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same.

Ground levels shall be taken prior to and after clearing and grubbing. Levels taken prior to clearing and grubbing shall be the base level and will be accordingly used for assessing the depth of clearing and grubbing and computation of quantity of any unsuitable material which is required to be removed. The levels taken subsequent to clearing and grubbing shall be the base level for computation of earthwork for embankment.

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

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

Removal of stumps and roots including back filling with suitable material to required compaction shall be a separate item and shall be measured in terms of number according to the sizes given below:-

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

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

201.6. Rates

206.6.1 The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300mm girth excavation and back-filling to required density, where necessary and handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads. Clearing and grubbing done in excess of 150 mm by the Contractor shall be made good by the Contractor at his own cost as per Clause 301.3.3 to the satisfaction of the Engineer prior to taking up earthwork. Where clearing and grubbing is to be done to a level beyond 150 mm, due to site considerations, as directed by the Engineer, the extra quantity shall be measured and paid separately.

201.6.2 The Contract unit rate for cutting trees of girth above 300 mm shall include handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

201.6.3 The Contract unit rate for removal of stumps and roots of trees girth above 300 mm shall include excavation and backfilling with suitable material to

required compaction, handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

201.6.4 The Contract unit rate is deemed to include credit towards value of usable materials, salvage value of unusable material and off-set price of cut trees and stumps belonging to the forest Department. The off-set price of cut trees and stumps belonging to the Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. In case the cut trees and stumps are required to be deposited with the Forest Department the Contractor shall do so and no deduction towards the off-set price shall be effected. The offset price shall be as per guidelines I estimates of the state Forest Department.

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

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Item No.2 Earthwork for embankment including breaking clods, dressing with all lead and lift (excluding watering and consolidation)(B) From Borrow area within all lead.

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth 30 cm. and less, loose stones; vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance; inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.
2. After clearing; the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc. required for setting out, establishing. Bench Marks and giving profiles: The contractor shall be responsible for maintaining the B. Ms. profiles alignment and other marks as long as they are required for the Work on the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.
3. When an existing, embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.
4. The soil to be used for embankment shall be free from trees stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and all lifts and within land width in the manner specified in Para 11 below. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed. (If not existing) and maintained by the contractor at his own cost.
5. Department will extend all necessary co-operation in helping contractor to get borrow area from nearby Government or Panchayat land; if available. However, department is not responsible if not such area is made available to the contractor and in the case contractor will have to make his own arrangement to get borrow area for borrowing earth of the quantity even by making temporary arrangement with the private land owners.
6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm: when being placed in the embankment and a maximum of size 5 cm when being placed in the

top 45 cm of the embankment, the work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm. so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new sub grade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt of the new sub grade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.
8. To avoid interference with the construction of abutment, wing walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item.
9. The embankment shall be finished in conformity with the alignment, levels, and cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.
10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earthwork in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections, longitudinal section etc, in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorised representative shall attend day to day levelling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall

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

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions:
- (i) The borrow pits will be so excavated as to from a road side longitudinal gutter to drain the water, interrupted by such gutter.
 - (ii) The width of the drain shall be restricted to 1.5 Mts, only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.
 - (iii) If there is top layer of black cotton or other objectionable soils; the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material.
 - (iv) The drain should be aligned along the boundary of the land width of the road. Not pit, other than this drain, shall be dug within 5 metres of toe to the final section of the road embankment.
 - (v) No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankment.
- 12.0 The rate of earthwork includes, clearing jungles, dog belling, fixing profiles, erecting necessary pillars for stones for bench marks for levelling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft Murrum, soft rock, hard Murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in the particular, item. No payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.
- 13.0 The Payment will be made on cubic meter basis of finished work.

Item No.3 Rolling and watering of earth work in layers with Vibratory roller including filling in depressions which occur during the process as directed

- 1.0 For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder.**

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

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

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

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

Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5meter portion of the embankment below the sub grade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of trucks or other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

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

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

Table 1.2

Table 1.2 Compaction requirements for embankment.

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

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

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

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

Stripping including storing and reapplication of top soil shall be measured as volume in cubic meter.

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

Item No.04 Providing All Time Temporary Diversion suitable for traffic during the construction period of the Bridge / Cd Work by levelling existing ground including earthwork for embankment and Supplying and spreading quarry spall in layer.

1. The item provides for the diversion of water course by suitable means such as constructing ring bunds, coffer-dams, channeling, islanding or any other suitable means as may be necessary and approved by Engineer-in-charge. This item will not include dewatering of foundations, trenches, which will be covered in the item of open excavation. The contractor shall take all necessary protective measure against possible erosion due to tide variations if any maintain the cofferdams, bund or island in proper manner during construction. He shall not be entailed for any payment or compensation in the event of washing of the coffer dam, bund or island at any time either due to tidal waters if any or floods, or any other reasons whatsoever and the contractor shall reconstruct the same, if required at his risk and cost, The size of the coffer dam, bund or island shall be such as would allow without obstructions and inconvenience enough working free space all around the foundation works.
2. The contractor shall plan, construct and maintain satisfactorily necessary diversion channels and protective works so as to safety pass the stream flow and also satisfactory meet with any sudden rise of flow due to tiles, flood or any other reasons, without damaging the foundation works. The cofferdam or bund shall be such as to give sufficient working space for constructions, inspection and installations of pumping machinery inside the enclosed area. The cofferdam or bund shall be of adequate section and properly designed, constructed to prevent ingress of water as practically as possible in the foundation pits and protect green concrete or masonry work.
3. Adequate pumping arrangement shall be made for dewatering the inside of cofferdam, bunds etc. Pumps of adequate capacity and in required number shall be provided to ensure adequate pumping.
4. The coffer dam, bund or inland shall be completely removed and their materials shall be disposed of on the manner by the Engineer-in-charge when no longer required.
5. The measurement for paying will be per RMT of pier or abutment for which diversion of watercourse etc. is required to be made. Unit of abutment will be inclusive of returns or wing walls attached to it.
6. The unit cost includes all materials labour and equipment to complete the job. Diversion of channels etc. will have to be construed and maintained till all operations to complete the entire bridge structure are complete as may be necessary.

Item No.05 Scarifying gravelled macadam or bitumen macadam surface 6 cm to 10 cm.depth including stacking useful materials on road side and disposing off remaining stuff.

- 1.0 The layer of the existing layer metalling / bituminous layer shall excavated for all depth as directed by Engineer-in-charge and shall be screened on site of work. Stacking of 75% of metal obtained from screening shall be done by filling in the standard steel boxes of 2m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent, otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas (2m x 15 mt. x 0.5 mt.) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in -any stack in a particular hectometer is found to be less then the standard measurements viz. 1.5 cmt. the entire collection in the hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a tairiy level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge.
- 2.0 The remaining material except 75% of metal obtained from screening process shall be used in embankment with all lead and lift. It shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited else where and subsequently convey to site of deposition. The sequence of operations should be arranged properly. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in manner approved by the Engineer-in-charge. The material utilised in the embankment will be deducted from the net quantity of earthwork in embankment arrived at within the chainage measured.
- 3.0 The payment shall be made on **Sq.mt.** basis, the contractor shall maintain all stacks in regular and proper size till the whole materials shall not be measured and finally accepted by the department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.
- 4.0 The rate includes the cost of scarifying macadam, screening, depositing, conveyance with all lead and lift, filling the boxes including all labour, tools, equipments and all other incidental expenses.

- Item No.06** Providing & laying compacted WBM 100mm thick Single layer as per MORTH specification using machine crushed M.C. Metal of size 45mm to 63mm with using 0.16 Cu.m./10 Sq.m. stone screenings 6mm to 10mm nominal size and binding materials @ 0.08Cu.m./10 Sq.m. including spreading in uniform thickness, watering and consolidation with vibratory roller etc. complete.

404.1 SCOPE

This work shall consist of clean, machine crushed B.T. stone aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared sub grade/ sub bases base or existing pavement, as the case may be and finished in accordance with the requirements of these specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

404-2. Materials

404.2.1 Coarse aggregates

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-8. The type and size range of the aggregate shall be specified in the contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

TABLE 400-8. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE / BASE COURSES

S.No. Test	Test Method	Requirement
1. *** Los Angeles Abrasion value or Aggregate Impact value	IS:2386 (Part-4) IS: 2386 (Part-4) or IS:5640*	40 percent (Max) 30 percent (Max)
2. Combined Flakiness and Elongation - Indices (Total)**	IS:2386 (Part- 1)	30 percent (Max)

* Aggregate which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS:5640.

** The requirement of flakiness index and elongation index shall be enforced only in the case of Crushed broken stone and crushed slag.

*** In case water bound macadam is used for sub-base, the requirements in respect of Los Angeles Value and Aggregate impact value shall be relaxed to 50 percent and 40 percent maximum respectively.

404.2.2 Crushed or broken stone

The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

404.2.3. Crushed slag :

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed

slag shall not be less than 11.2 kN per m³ and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- (i) Chemical stability of : To comply with requirement of appendix
BS : 1047
- (ii) Sulphur content : Maximum 2 per cent
- (iii) Water absorption : Maximum 10 per cent

404.2.4. Overburnt (Jhama) Brick aggregates :

Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials. This shall be used only for road stretch when traffic is low.

404.2.5. Grading requirement of Coarse aggregates :

The coarse aggregates shall conform to one of the Gradings given in Table 400-9 as specified.

404.2.6. Screenings:

Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as murrum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

TABLE 400-9 : GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	63 mm to 45 mm	75 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
2.	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

Note : The compacted thickness for a layer shall be 75mm.

Screenings shall conform to the grading set forth in Table 400-10. The quantity of screenings required for various grades of stone aggregates are given in Table 400-11. The table also gives the quantities of materials (loose) required for 10 m² for sub-base / base compacted thickness of 75 mm.

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites etc. as they are likely to get crushed to a certain extent under rollers.

404.2.7 Binding Material :

Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS:2720 (Part 5).

The quantity of binding material where it is to be used will depend on the type of screening. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06 – 0.09 m³ / 10 m².

TABLE 400 – 10. GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		9.5 mm	80-100
		5.6 mm	50-70
		180 micron	5-25

TABLE 400 – 11.
APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS
REQUIRED FOR 75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM
(WBM) SUB-BASE / BASE COURSE FOR 10 M² AREA

Classification	Size Range	Compact thickness	Loose Qty.	Screenings			
				Stone screening		Crushable type such as murrum or gravel	
				Grading classification and size	For WBM sub-base / base course (loose Qty)	Grading classification and size	Loose Qty.
Grading 1	63mm to 45 mm	75 mm	0.91 to 1.07m ³	Type A 13.2 mm	0.12 to 0.15 m ³	No uniform	0.22 to 0.24 m ³
- do -	- do -	- do -	- do -	Type B 11.2 mm	0.20 to 0.22 m ³	- do -	- do -
Grading 2	53mm to 22.4 mm	75 mm	- do -	- do -	0.18 to 0.21 m ³	- do -	- do -

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as murrum or gravel.

404.3 Construction Operations

404.3.1 Preparation of base :

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

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

As far as possible, laying water bound macadam course over an existing bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it.

404.3.2 Inverted Choke / Sub surface Drainage layer

If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.3.3 Lateral Confinement of Aggregates

For construction of WBM, arrangement shall be made for the lateral confinement of aggregates. This shall be done by building adjoining shoulders along with WBM layers. The practice of constructing WBM in a trench section excavated in the finished formation must be completely avoided.

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

404.3.4 Spreading coarse aggregates:

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub grade/sub-base/ in the required quantities from the stock piles to proper profile by using templates placed across the road about. 6 m apart, in such quantities that the thickness of each compacted layer is not more than 75 mm. In no case shall these be dumped in heaps directly on the area where there are to be laid nor shall their hauling over a partly completed base be permitted. Wherever possible approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimize the need for manual rectification afterwards.

No segregation of coarse aggregate shall be allowed and the coarse aggregates, as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregate spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

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

404.3.5 Rolling:

Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

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

Rolling shall be carried out on courses where coarse aggregates of crushed / broken stone are used, till the road metal is partially compacted. This will be followed by application of screening and binding material where required in Clauses 404.3.6 and 404.3.7.

However, where screenings are not to be applied as in the case of aggregates like brick metal laterite and kankar for the sub base construction, the compaction shall be continued until the aggregates are thoroughly keyed. Rolling shall be continued and

light sprinkling of water shall be done till the surface is well compacted. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub grade or sub base course.

The rolled surface shall be checked transversely with templates and longitudinally with 3 m. straight edge. Any irregularities exceeding 12mm shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

404.3.6 Application of screenings:

After the coarse aggregate have been rolled to Clause 404.3.5, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse Aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion & of hand shovels or by mechanical spreaders or directly from tipper with suitable grit spreading arrangement Tipper operating for spreading the screenings shall be equipped with pneumatic tyres and operated so as not to disturb to coarse aggregates.

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

The spreading, rolling and booming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

404.3.7 Sprinkling of water and grouting :

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

In case of lime treated soil sub-base, construction of water bound macadam on top of it shall be taken up after curing as per Clause 402.3.9 and as directed by the Engineer.

Application of binding material : After the application of screenings in accordance with Clauses 404.3.6 and 404.3.7, the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, form a wave ahead of the wheels of the moving roller.

404.3.8 Setting and drying :

After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material 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 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.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

404.4 Surface Finish and Quality Control of Work

404.4.1 The surface finish of construction shall conform to the requirements of Clause 902.

404.4.2 Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

404.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 10° C in the shade.

404.4.4 Reconstruction of defective macadam :

The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub grade soil mixing, with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and re-compacted. The area treated shall not be less than 10 sq.m. In no case shall depressions be filled up with screenings or binding material.

404.5 Arrangement for Traffic

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

404.6 Mode of Measurement & payment

Water bound macadam shall be measured as finished work in position in cubic meters.

404.7 RATE

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed below including arrangement of water used in the work as approved by the Engineer.

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

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Item No.07 Providing and laying and rolling 37.50mm thick bituminous groutin with B.T. aggregate as per Required Gradation and using bitumen Grade VG-30 for Mixing at the rate of 1.99% i.e. 19.90 kg/M.T. of total mix and VG-30 for tack coat at the rate of 2.5 kg/10sq.mt on existing B.T. surface including heating and mixing in Drum mix plant ,trasporting spreading same by paver finisher and consolidation by viberated roller including necessary firewood, oil,kerosene, lubricants all equipments, tools, labour charges etc. complete using contractor's own machinary in accordance with the requirement of specification.

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. Thickness of the course shall be 37.5mm materials.

Materials

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

Aggregates

The aggregates shall consist of crushed stone, crushed gravel/shingle 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. 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 GROUT

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

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

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

Proportioning of materials:

The bitumen content for premixing shall be 1.99 % (percent) by weight of the total mix except when otherwise directed by the Engineer.

The maximum compacted thickness of a layer shall be 37.5mm

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

AGGREGATE GRADING FOR BITUMINOUS GROUT

IS Sieve	Percent by weight passing the sieve	Designation
53.0 mm	100	
26.5 mm	75-100	
22.4 mm	50-85	
13.2 mm	20-40	
5.6 mm	5-20	
2.8 mm	0 – 5	

Variation in proportioning of materials : 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.

Construction Operations:

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 atmospheric temperature in shade is 10 degree C or less.

Preparation of base : This work shall consist of preparing an existing granular or blacktopped surface bituminous course. The work shall be performed on such widths and lengths as shown in application drawing or as directed 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. Water Bound Macadam or Clause 406. Wet Mix Macadam, as the case may be.

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. If 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 as the layer over which it is to be laid or intermediate between underlying layers, as shown on the Drawing.

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.

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 10DC. 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, quipped 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 and sprayer or as directed by the Engineer 503.4.2 of MORTH specification. **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 501.8 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 specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in TABLE 500-2 of MORTH specification. The normal range of spraying.

TABLE 500-2 RATE OF APPLICATION OF TACK COAT:

The emulsion asphalt 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 cut back 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 of MORTH specification 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 pany or vehicles shall be allowed on the tack coat other than those essential for the construction.

Quality Control of Work :

TOLERANCES IN SURFACE LEVELS

1.	Sub grade	+	20mm 25mm
2.	Sub-base 4 - 10 mm		
	(a) Flexible pavement	-	20mm
	(b) Concrete pavement	+	6mm
	[Dry clean concrete or Rolled-concrete]		10mm
3.	Base - course for flexible pavement	+	6mm
	(a) Bituminous course	-	6mm
	(b) Other than bituminous	+	10mm
	(i) Machine laid	-	10mm
	(ii) Manually laid	+	15mm
			15 mm
4.	Wearing course for flexible pavement		
	(a) Machine laid	+	6mm
			6mm
	(b) Manually laid	+	10mm
			10mm
5.	Cement concrete pavement	+	5mm
		-	6mm

TACK COAT :

Scope:

This work shall consist of the application of a single coat of high viscosity liquid bituminous material to an existing bituminous road surface

preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

Materials:

The binder used for tack coat shall be bitumen emulsion complying with IS:8887 of a type and grade as specified in the Section 500 of MORTH specification 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:

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

Specification: The rate shall cover the provision of **tack coat at 0.25 kg** per square meter with provision that the variation in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

Preparation and transport of mix:

Bituminous grout 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.

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'.

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.

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

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.

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.

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.

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:

Loading hoppers and suitable distributing mechanism.

All drives having hydrostatic drive/control.

The machine shall have a hydraulically extendable screed the appropriate width requirement.

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

The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.

The screed shall have the internal heating arrangement.

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.

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 120°C to 160°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 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.

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 built-up spray grout shall be provided with next surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

Arrangement for Traffic:

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

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** 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. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank : of supervisor of department and the measurement shall be recorded by the Deputy Engineer or Assistant Engineer or Addl. Asst. Engineer. If so authorized, record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representative and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded shall be recorded carefully.

RATE :

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

Making arrangements for traffic to Clause 112 of MORTH specification except or initial treatment to verge, shoulders and construction of diversion.

Preparation of base except for laying of profile corrective course but including filling of potholes.

Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.

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.

Carrying out the work in part widths of the road where directed.

Carrying out all tests for control of quality.

Item No.08 Providing and laying 50.00 mm thick B.M. With BT Aggregate VG-30 grade bitumen for Tack coat @ 2.50 kg/10 sqm using crushed stone aggregate 0.66 cum/ MT as per MORTH&H Specification & VG-30 grade bitumen for mixing @35.00 Kg/1 MT i.e. 3.5% of by weight of total mix incl. heating and mixing by drum mix plant and spreading the same with paver finisher consolidation with vibratory roller including cost of fuel, hire charges, all necessary equipments, tools and plant, fire wood, oil, kerosene labour changes etc complete.(Using contractor's own Machinery)

504 BITUMINOUS MACADAM

504.1 Scope

This work shall consist of construction in a single course having 50 mm to 100 mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Since the bituminous macadam is an open-graded mix, there is a potential that it may trap water or moisture vapour within the pavement system. Therefore, adjacent layer (shoulders) should have proper drainage quality to prevent moisture-induced damage to the BM.

504.2 MATERIALS

504.2.1 BITUMEN

The bitumen shall be viscosity graded paving bitumen complying with Indian Standard Specification for paving bitumen, IS:73 or as specified in the Contract. The type and grade of bitumen to be used would depend upon the climatic conditions and the traffic. Guidelines for selection of bitumen are given in Table 500-1.

504.2.2 COARSE AGGREGATES

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other deleterious substances. The aggregate shall satisfy the physical requirements specified in Table 500-6. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation. Before approval of the source, the aggregates shall be tested for stripping. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment.

504.2.3 FINE AGGREGATES

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of two, passing 2.36 mm sieve and retained on 75 micron sieve. It shall be clean, hard, durable, free from dust and soft organic and other deleterious substances. Natural sand shall not be used in the binder course.

TABLE 500-6 : PHYSICAL PROPERTIES OF COARSE AGGREGATE

Property	Test	Requirement	Test method
Cleanliness	Grain size analysis	Max. 5% passing 0.075 micron	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max. 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or	Max. 40%	IS:2386 Part IV
	Aggregate Impact Value	Max. 30%	IS:2386 Part IV
Durability	Soundness (Sodium or Magnesium)	5 cycles	
	Sodium Sulphate	Max. 12%	IS:2386 Part V
	Magnesium Sulphate	Max. 18%	IS:2386 Part V
Water absorption	Water absorption	Max. 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate	Min. Retained Coating 95%	IS:6241
Water sensitivity	Retained Tensile strength*	Min. 80%	AASHTO 283

- If the minimum retained tensile strength falls below 80 percent, use of anti stripping agent is recommended to meet the minimum requirements.

504.2.4 AGGREGATE GRADING AND BINDER CONTENT

The combined grading of the coarse aggregates and fine aggregates, when tested in accordance with IS:2386 Part 1, wet sieving method, shall conform to limits given in Table 500-8. The type and quantity of bitumen and appropriate thickness is also given in Table 500-7.

504.2.5 PROPORTIONING OF MATERIAL

The combined aggregate grading shall not vary from the lower limit on one sieve to the higher limit on the adjacent sieve to avoid gap grading. The aggregate may be proportioned and blended to produce a uniform mix complying with the requirements in Table 500-7. The binder content shall be within a tolerance of 0.3 percent by weight of total mix when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

504.3 CONSTRUCTION OPERATION

504.3.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

TABLE 500-7: AGGREGATE GRADING AND BITUMEN CONTENT

Table 500-7 : Aggregate Grading and Bitumen Content

Grading	1	2
Nominal maximum aggregate size*	40 mm	19 mm
Layer thickness	80 -100 mm	50 -75 mm
IS Sieve size (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 ** percent by mass of total mix	3.3**	3.5**

* Nominal maximum aggregate size is the largest specified sieve size upon which any of the aggregate material is retained.

** Corresponds to specific gravity of the Aggregate being 2.7. In case aggregates have specific gravity more than 2.7, bitumen content can be reduced proportionately. Further, for regions where highest daily mean air temperature is 30°C or lower and lowest daily mean air temperature is -10°C or lower, the bitumen content may be increased by 0.5 percent.

504.3.2 PREPARATION OF THE BASE

The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clauses 501.8 and 902.3 as appropriate, and a prime coat, shall be applied in accordance with Clause 502 where specified, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

504.3.3 TACK COAT

A tack coat in accordance with Clause 503 shall be applied as required under the Contract or as directed by the Engineer.

504.3.4 PREPARATION AND TRANSPORTATION OF THE MIX

The provisions of Clauses 501.3 and 501.4 shall apply.

504.3.5 SPREADING

The provisions of Clause 501.5.3 Shall apply.

504.3.6 ROLLING

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7.

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

504.4 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of the completed construction shall conform to the requirements of Clause 902. For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

504.5 PROTECTION OF THE LAYER

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

504.6 ARRANGEMENTS FOR TRAFFIC

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

504.7 MEASUREMENT FOR PAYMENT

Bituminous macadam shall be measured as finished work in cubic metres, or by weight in metric tonnes, where used as regulating course, or square metres at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

504.8 RATE

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include cost for all components listed in Clause 501.8.8.2.

Item No.09 Providing and laying 20 mm thick average for Mix seal surface using stone chips @66% by weight, gradation as per MORTH specification and using bitumin VG 30 grade for mixing rate not less than 50.90KG/MT on BT surface using stone chips as per MORTH specification including heating the asphalt and aggregates by hot mix plant and spreading the same with paver finisher including consolidation with vibratory roller and providing, operating plant machineries, equipments, tools, plants, oil, fire wood, kerosene and all labour charges etc. complete.

508 CLOSE-GRADED PREMIX SURFACING/MIXED SEAL SURFACING

508.1 SCOPE

508.1.1 The work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

508.1.2 Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents. Type A grading is recommended for use in areas having rainfall more than 150 cm per year. In other areas Type B grading may be used.

508.2 MATERIALS

508.2.1 BINDER

The provisions of Clause 510.1.2.1 shall apply.

508.2.2 COARSE AGGREGATES

The provisions of Clause 511.1.2.2 shall apply.

508.2.3 FINE AGGREGATES

The fine aggregates shall consist of crushed rock, or natural sand or a mixture of both. These shall be clean, hard durable, un-coated, mineral particles, dry: and free from injurious, soft or flaky particles and organic or deleterious substances.

508.2.4 AGGREGATE GRADATION

The coarse and fine aggregates shall be so graded or combined as to conform to one or the other gradings given in Table 500-19 as specified in the contract.

Table 500-19 : Aggregate Gradation

IS Sieve Designation (mm)	Cumulative Percent by Weight of Total Aggregate Passing	
	Type A	Type B
13.2 mm	—	100
11.2 mm	100	88 – 100
5.6 mm	52 – 88	31 – 52
2.8 mm	14 – 38	5 – 25
0.090 mm	0 – 5	0 -5

508.2.5 PROPORTIONING OF MATERIALS

The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 20mm thick. The quantity of binder used for premixing shall be 50.90 Kg/MT for Type A and Type B surfacing respectively.

508.3 CONSTRUCTION OPERATIONS

The provisions of Clause 510.1.3.1 through Clause 510.1.3.5 shall apply.

508.4 OPENING TO TRAFFIC

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Speed restrictions may be imposed at initial stages.

508.5 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

508.6 ARRANGEMENTS FOR TRAFFIC

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

508.7 MEASUREMENT FOR PAYMENT

Close-graded premix surfacing, Type A or B shall be measured as finished work, for the area specified to be covered, in square metres at a specified thickness. The area will be the net area covered.

508.8 RATE

The contract unit rate for close-graded premix surfacing, Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

509 SURFACE DRESSING

509.1 SCOPE

This work shall consist of the application of one coat or two coats of surface dressing, each coat consisting of a layer of bituminous binder sprayed on a previously prepared, base, followed by a cover of stone chips rolled in to form a wearing course to the requirements of these Specifications.

509.2 MATERIALS

509.2.1 BINDER

The binder shall either be bitumen conforming to IS:73 or rapid setting cationic bitumen emulsion (RS-2) conforming to IS:8887. Grade of bitumen shall depend upon the climatic condition. For selection of grade of bitumen guidance may be taken from Table 500-1. The type of binder to be used shall be stated in the Contract, or as directed by the Engineer.

509.2.2 AGGREGATES

The stone chips (cover aggregate) shall conform to the requirements of Clause 505.2.2.. except that their water absorption shall be restricted to a maximum of 1 percent and they shall have a Polished Stone Value of minimum 60. [in BS:812 (Part-114)], of not less than 60. The size of the aggregate shall depend upon the type of surface on which it is laid and the traffic intensity. The chips shall be single sized,

clean, hard, durable, of cubical shape: and free from dust and soft or friable matter, organic or other deleterious matter and conform to one of the gradings given in Table 500-21. The size of the aggregate shall depend upon the type of surface on which it is laid and the traffic intensity. Table 500-20 may be used as guidance.

PRE-COATED CHIPS: As an alternative to the use of an adhesion agent or wherever specified in the Contract, the chips may be pre-coated before they are spread except when the sprayed binder film is a bitumen emulsion. Pre-coating the chips may be carried out by mixing aggregates with 0.75 to 1.0 percent of bitumen by weight of chips in a suitable mixer. The chips shall be heated to 160°C and mixed with the binder heated to its application temperature. The pre-coated chips shall be allowed to cure for at least one week or until they become non sticky and can be spread easily.

Table 500-20 : Recommended Nominal Size of Aggregates (mm)

Type of Surface	Traffic Intensity in Terms of Number of Vehicles Per Day in the Lane Under Consideration		
	1000-2000	200-1000	20-200
Very hard	10	6	6
Hard	13	10	6
Normal	13	10	6
Soft	19	13	13
Very soft		19	13

Table 500-21 : Grading requirements for Aggregates used for Surface Dressing

IS Sieve Designation (mm)	Cumulative Percent by Weight of Total Aggregates Passing for the Following Nominal Sizes (mm)			
	19	13	10	6
26.5	100			
19	85-100	100		
13	0-40	85-100	100	
9.5	0-7	0-40	85-100	100
6.3		0-7	0-35	85-100
4.75			0-10	
3.35				0-35
2.36	0-2	0-2	0-2	0-10
0.60				0-2
0.075	0-1.5	0-1.5	0-1.5	0-1.5
Minimum 65% by weight of aggregate	Passing 19 and retained on 13.2	Passing 13.2 and retained on 9.5	Passing 9.5 and retained on 6.3	Passing 6.3 and retained on 3.35

509.2.3 RATES OF SPREAD OF BINDER AND CHIPS

The rate of spread of binder and chips will depend upon the nominal size of the aggregate and the extent of its embedment into the surface. The rate shall be determined as per the procedure given in Manual for Construction and Supervision of Bituminous Construction. Approximate rate of application of aggregates, and binder under average conditions are given in Table 500-22.

Table 500–22 : Approximate Rate of Application of Binder and Aggregates

Nominal Aggregate Size mm	Binder (Kg/m ²)			Aggregates Cu.m/m ²
	Uncoated Aggregates		Coated Aggregates	
	Bitumen	Emulsion	Bitumen	
19	1.2	1.8	1.0	0.014-0.015
13	1.0	1.5	0.8	0.009-0.011
10	0.9	1.3	0.7	0.007-0.009
6	0.75	1.1	0.6	0.003-0.005

Note : Bitumen for coated aggregates excludes quantity of bitumen required for coating.

509.2.4 ANTI-STRIPPING AGENT

Where the proposed aggregate fails to pass the stripping test then an approved anti-stripping agent (Appendix 4 for details) may be added to the binder in accordance with the manufacturer's instructions. The effectiveness of the proposed anti-stripping agent must be demonstrated by the Contractor, before approval by the Engineer.

509.3 CONSTRUCTION OPERATIONS

509.3.1 Weather and Seasonal Limitations

Clause 501.5.1 shall apply.

509.3.2 PREPARATION OF BASE

The base on which the surface dressing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with Clause 501 or as directed by the Engineer. Prime coat, where needed, shall be provided as per Clause 502 or as directed by the Engineer. Where the existing surface shows signs of fatting up, the excess bitumen shall be removed as directed by the Engineer. The bituminous surface to be dressed shall be thoroughly cleaned either by using a mechanical broom and/or compressed air, or any other approved equipment/method as specified in the Contract or directed by the Engineer. The prepared surface shall be dust free, clean and dry , (except in the case of cationic emulsion where the surface shall b slightly damp)

509.3.3 APPLICATION OF BINDER

After preparation of base, paving grade binder heated to an appropriate temperature or bitumen emulsion shall be sprayed uniformly using mechanical sprayers. During the operation the ratio between truck speed and pump revolution shall be maintained constant with the help of automatic control. When work resumes, the binder shall not be sprayed on the earlier completed surface. This can be done by covering the completed work with bitumen impregnated paper. Excessive deposit of bituminous material shall be immediately removed. The equipment described in IRC:SP:34 with synchronized spraying and compaction shall be preferred for better control and uniformity in construction.

The spraying temperatures for binder are given below:

Binder Grade	Whirling Spray Jets		Slot Jets	
	Min°C	Max°C	Min°C	Max°C
VG 30	180	200	165	175

509.3.4 APPLICATION OF STONE CHIPS

Immediately after application of the binder, clean, dry chips (in the case of emulsion the chippings may be slightly damp) shall be spread uniformly by means of a mechanical chip spreader on the surface so as to cover the surface completely with a single layer of chips.

509.3.5 ROLLING

Rolling of the chips should preferably be carried out by a pneumatic tyre roller in accordance with Clauses 501.6 and 501.7. Rolling shall commence at the edges and progress towards the centre except in super-elevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. While rolling is in progress, additional chips shall be spread by hand in necessary quantities required to make up irregularities. Rolling shall continue until all aggregate particles are firmly embedded in the binder and present a uniform closed surface.

509.3.6 APPLICATION OF SECOND COAT OF SURFACE DRESSING

Where surface dressing in two coats is specified, the second coat should not be applied until the first coat has been open to traffic for two weeks. The surface on which the second coat is laid must be clean and free of dust. The construction operations for the second coat shall be the same as described in Clauses 510.3.3 to 510.3.5.

509.4 OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly surface dressed area until the following day. In special circumstances, however, the Engineer may allow the road to be opened to traffic immediately after rolling, but in such cases traffic speed shall be limited to 20 km per hour until the following day.

509.5 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of Clause 902.

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

509.6 ARRANGEMENTS FOR TRAFFIC

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

509.7 MEASUREMENT FOR PAYMENT

Each coat of surface dressing shall be measured as finished work for the area instructed to be covered, in square metres.

509.8 RATE

The Contract unit rate for surface dressing, based on the approximate rates of application for binder given in Table 500-22 and each size of chippings given in Clause 509.2.3, shall be adjusted, plus or minus, for the difference between the approximate rate of spread and the rate of spread determined based on design and approved by the Engineer. The adjusted rate shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

Item No.10 Demolition including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift.(ii) In RCC work

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. That Demolition of R.C.C. work is to be done .

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 cement 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 arid providing temporary enclosures or portions where considered necessary.

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

Item No.11 Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed upto all lead.

1.0 This work shall consist of excavation removal and satisfactory disposal of all materials necessary for the construction of roadway and the lines, grades and cross sections shown in the drawing or as indicated by the Engineer.

2.0 CLEARING AND GRUBBING THE SITE

2.1 S C O P E

This work shall consist of removing and disposing of all materials such as trees, bushes, shrubs, slumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc. Which in the opinion of the Engineer are unsuitable for incorporation in the works. From the area of road Land containing road embankment, drains, cross drainage structures and such other areas as may be specified on the drawing or by the Engineer. It shall include necessary excavation, back filling of pits resulting from uprooting of trees and slumps to required compaction, handling, salvaging and disposal of cleared materials, clearing and grubbing shall be performed in advance of earth work operations and accordance with the requirements of these specifications.

2.2. PRESERVATION OF PROPERTY / AMENITIES

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

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

2.3. METHOD, TOOLS AND EQUIPMENT

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property shall be adopted for the work. If the area has thick vegetation, roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purpose. The dozer shall have ripper attachments for removal of tree slumps. All trees, slumps, etc. falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500mm of the sub grade. Also all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the embankment/slab grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and slumps required to be removed as directed by the Engineer shall be cut down to 1 m. below ground level so that these do not present an unsightly appearance.

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

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

The payment shall be made on Cubic Meter basis.

Item No.12 Providing & filling in foundation with ordinary cement concrete M 100 mix & providing necessary vertical pin headers including formwork, vibrating ramming and curing complete.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.
2. In the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg. / cm².
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cubic metres in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per I.S.: 2386 (Part - III).
4. Ingredients required for ordinary concrete containing one 50 Kg bag of cement of different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by Volume	Total quantity of dry aggregate by volume per 50 Kg. / of cement to be taken as per sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate.	Quantity of water per 50 Kg. of cement maximum.
1	2	3	4	5
Ordinary	Liters			Liters
M-100	1:3:6	300	Generally 1 : 2	34
M-150	1:2:4	220	for aggregate	32
M-200	1:1 ½ :	160	to coarse	30
M-250	3	100	aggregate by	27
M-350	1 : 1 : 2		volume but subject to and upper limit of 1 : 1 ½ and a lower limit 1 : 3	

NOTE - The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of coarse aggregate becomes larger.

Example - For an average grading of fine aggregate (that is Zone II of I.S.: 383-1963) the proportions shall be 1:1.1/2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm. and 40 mm. respectively (after carrying out sieve analysis).

Note-2 A mix leaner than M.100 (1:3:6) may be used for non- structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregate
(i)	R.C.C. well curb, R.C.C. well staining and R.C.C. pipes	40 mm.
(ii)	R.C.C. well staining	63 mm
(iii)	Well cap or pipe cap; solid type pipes abutment and wing-walls, and their pipe caps	40 mm
(iv)	R.C.C. works in cross girders deck slab, wearing coats, kerb, light posts, blast walls, approach slab etc. and hollow type piers, abutment, wing-walls and their pier caps.	20 mm
(v)	R.C.C. bearings	20 mm
(vi)	For any other item of construction not covered by items (i) to (v)	As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement, whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.
9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and

after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in- charge, concrete shall be deposited in horizontal layers to neither a compacted depth of nor more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.
16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-

charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. From work shall include all temporary or permanent forms required for forming the concrete together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories:
 - (1) Shuttering i.e., form work required for forming the concrete.
 - (2) Scaffolding i.e., form-work required for supporting shuttering.Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal. Both shuttering and scaffolding shall be or substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings: All bolts and rivets shall be counter-sunk and well ground to provide a smooth, plane surface. Only steel formwork shall be used.
19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable comber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in- charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre stressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works:
21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred

deformation due to various causes affecting pre stressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the form work, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the form work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.
23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.
24. In the case of reinforced concrete work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend up on the nature of work and methods of

vibration of concrete shall be determined by regular slump tests. Following slump shall be adopted for different types of works.

Sr. No.	Type of Work	Slumps	
		Where vibrators are used	Where vibrators are not used
(i)	Mass concrete in R.C.C. foundations, footings and retaining walls	10 mm to 25 mm	80 mm
(ii)	Beams, slabs and columns simply reinforced	25 mm to 40 mm	100 mm to 120 mm
(iii)	Thin R.C.C. section or section with congested steel.	40 mm to 50 mm	125 mm to 150 mm

25. Works strength tests shall be made in accordance with I.S.: 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.
26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, Kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Assistant Engineer / Additional Assistant Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work check that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.
29. All necessary labour, materials equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.
30. The payment will be made on cumt basis of the finished work.

31. The unit rate of concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centers and forms required for the work.

- Item No.13** Providing and casting in situ Ordinary trimix cement concrete M-200 for average 150mm thick road work laid as directed including adding super plasticizer admixture of IS make and providing and laying M.S. side rail of road thickness with necessary nut bolts plates fixing as per width applying plate vibrator (electric or diesel) on channel compressor with vacuum dewatering system by using all necessary equipments and materials and machinery such as running screed vibrator on pre-laid M.S. channel for leveling, Vacuum pump, floating and power trowelling etc with filling the joints with bitumen as directed etc complete.

The Work shall be carried out as per this tender item no. 13 except that concreting shall be done in M-250 grade and other changes as below.

I] MATERIALS :-

Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-6, Grit shall conform to M-8 and coarse aggregate shall conform to M-12, 200 Micron thick LDPE membrane shall be of approved quality. CONPLAST P-211 water reducing concrete materials shall be approved quality.

[II] WORKMANSHIP :-

Cutting for sub-base shall be done in proper grade and camber as directed by Engineer-in-Charge. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done in instruction. Useful stuff shall be carefully stacked separately as directed. The stuff received from the cutting shall be utilized for filling cuts and correcting side slopes with all lead and lifts as directed.

Sub-base with M.C Metal & murrum shall be prepared as directed by Engineer-in-Charge.

Before placing concrete, a minimum 200-Micron thick plastic over the prepared sub-base as per instruction which act as a separation layer to protect the floor against humidity and capillary water from the earth.

11.5 thicker M-200 grade concrete is being placed over the prepared sub-base. Complast P-211 (Water reducing concrete admixture) @ 100Mt. per bag of cement and Recron-35 fibers at 125 Gms. per bag of cement shall be used in M-200 concrete mix. The relevant Specification of Item No.5.8.2 (General Specification for building) shall be followed for M-200 mix concrete and relevant specification No. 13 shall be followed for work required for concreting.

Leveling of the surface is done using TREMIX surface vibrator. The vibrator runs over channels, placed as per required level and slope and simultaneously level surface of the concrete.

Vacuum dewatering follows the leveling of concrete. The purpose of vacuum processing is to provide quicker setting and high early strength by removing surplus water from the concrete. The process is followed as per instruction of site Engineer-in-Charge & attached guide line.

Immediately after dewatering, the surface is floated with a skim power floater as per instruction Engineer-in-Charge. The surface shall be prepared as per requirements and instructions. For smoother surface requirement, the surface is

trowelled with same machine mounted with trowelling blades. If required floor hardener "Nitoflor Hardtop" a Fasroc product shall be used at the rate of 3 to 5 Kg./Sqm. to get hard wearing surface.

Construction joints upto $\frac{1}{4}$ of the slab depth are cut after wards. They give clear and straighter theoretical cracking line in the case of unexpected stresses. Groove cutting is done within 48 hour from casting at the floor.

After surface vibrator and finishing the surface with power floater and trowel light brooming on the surface, expansion joints size 20 x 115mm shall be provided with filling the expansion joint having size 20 x 20mm by using COLPOR-200 as per manufacturers specification and directed by Engineer-in-Charge. The expansion joints filled with Nitogoal 200.

Making a construction joints by cutting of joints of size 3mm x 20mm by using of concrete cutter machine construction joint are filled with "MITOSEAL-280" an elastomeric cold applied joint sealant, which ensures performance of expected functions at the joints.

Concrete should be cured in normal way (Water pending) or the surface is covered with a plastic sheet or gunny bags. In any method, the surface should be always kept wet with water. Curing must be done for atleast 7 days or as per directed by Engineer-in-Charge.

The machineries used for the above process shall be of standard technical specification attached separately herewith. (i.e. Surface vibrator, vacuum pump, suction mat top cover, filter pad, skim floater etc.)

The Workmanship and process for vacuumed dewatering, water cement ration, concrete placing, surface vibration, vacuum processing, floating, Trowelling and curing shall be carried out as per attached literatures and as per instruction of Engineer-in-Charge.

[III] MODE OF MEASUREMENT :

The rate shall be include all materials, formworks, machineries and labour charges.

The rate shall be for a unit of one Cum.

Item No.14 Excavation for foundation in Hard Murrum upto all depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto all lead and lift.

1. Excavation for structure shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls pipe culverts and other similar structures, in accordance with the requirements, of these specification and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall be include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, shrubs and other deleterious matter and obstruction necessary for the foundations trimming bottoms of excavation backfilling and clearing up to site disposal of all surplus materials.

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves slopes grade and sections as shown on the drawing or as directed by the Engineer-in-charges. The Contractor shall provide all labour, survey instruments and materials such as strings, page nails bamboos stones lime, mortar, and concrete etc. required in connection with the sitting out of works and the establishment of benchmark centre line stones and other marks 0and stakes as long as in the opinion of the Engineer-in-charges, they are required for the work.

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

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

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

6. Pumping form the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete No. pumping shall be permitted during the placing of concrete or for any period of at least 24 Hours thereafter,

unless it is done from a suitable sump separated from the concrete work by a water tight or other similar means.

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

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

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

10. All the excavation materials shall be the property of the Government. Where the excavation materials are to be used in the construction of embankment, it shall be directly deposited at the required location, within 100 metres lead.

11. All useful materials not intended for use in the bank shall be stacked neatly on Government land as directed by the Engineer-in-charges within 100 metres lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charges.

12. Excavation for structure shall be measured in cubic metres for each class of materials encountered to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.

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

1. Setting out and fixing bench marks and centre line stones.

2. Construction of necessary shoring and bracing and their subsequent removal.

3. Removal of all logs, stumps. Grubs and other deleterious matter and obstructions for placing the foundation including trimming of bottoms of excavations:

4. Foundation sealing, dewatering including pumping.

5. Backfilling, clearing up the site and disposal of all surplus materials within all lifts and lead upto 100 metres.

6. All labour materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.

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

Item No.15 Excavation for foundation in Soft rock not requiring Blasting upto all depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto all lead.

1. Excavation for structures shall consist of the removal of material for the construction of foundation for bridges culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures in advance with the requirements of these specifications and the lines and dimensions shown on the drawings or as indicated by the engineer-in-charge. The work shall include all necessary sheeting, shoring bracing, draining and pumping and the removal of all logs stumps shrubs and other deleterious matter and obstructions necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings pegs nails, bamboos, stones, lime, mortar, concrete, etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as in the opinion of the engineer-in-charge, they are required for the work.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall due regard to the safety of personal and works and to the satisfaction of the engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the engineer-in-charge.
5. Where water is met with in excavation due to stream flow, seepage, snags, rain or other reasons, the contractor shall take adequate measures such as bailing pumping, to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the engineer-in-charge. Approval of the engineer-in-charge shall, however not relieve the contractor of the responsibility for the adequacy of dewatering, and production arrangements and for the quality and safety of the works.
6. Pumping from the interior of any foundation enclosure shall be done in such aggregate manner as to preclude the possibility of movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the engineer-in-charge the extra depth shall be made good with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any sips or blows in the excavation, these shall be removed by the contractor at his own cost.
8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate

- protective measures to see that the excavation operations do not affect or damage adjoining structures.
9. Backfilling shall be done with approved materials after concrete of masonry is fully set and carried out in such aggregate way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250mm loose layers, which shall be watered and compacted.
 10. All the excavated materials shall be the property of the government. Where the excavated materials are to be used in the construction of embankment, it shall be directly deposited at the required location, within 100 meters lead.
 11. All useful materials not intended for use in the bank, shall be stacked neatly on government land as directed by the engineer-in-charge within 100 meters lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the engineer-in-charge.
 12. Excavation for structures shall be measured in cubic meters for each class of material encountered, limited to the dimension shown on the drawing or as directed by the engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor. In executing the work and shall not be measured and paid for separately.
 13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including:
 1. Setting out and fixing bench marks and centre line stones.
 2. Construction of necessary shoring and bracing and their subsequent removal.
 3. Removal of all logs, stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations :
 4. Foundation sealing, dewatering including pumping;
 5. Backfilling clearing up the site and disposal of all surplus material within all lifts and lead upto 100 metres;
 6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work of the specification.
 14. Excavation shall be for ordinary soil such as vegetation or organic soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, or other ordinary digging equipment. Removal of gravel or any other cocular material having diameter in any one direction not exceeding 75mm. occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.
 15. Excavation shall be in hard soil such as stiff heavy clay, hard shale or compact murrum requiring grating tool or pick or both and shovel. Closely applied and ravel and rubble stone having maximum cemetery in any one direction between 75 and 300 mm and soft conglomerate. The classification of excavation shall be decided by the Engineer -in-charge and his decision shall be final and binding on the contractor.
 16. The Payment Shall be made on Cum Basis

Item No.16 Excavation for foundation in hard murrum and boulders and very stiff or sticky, clays and other similar strata including shoring and strutting and dewatering as necessary and disposing of the excavated stuff as directed .

1. Excavation for structures shall consist of the removal of material for the construction of foundations for culverts, retaining walls, cut of walls pipe culverts and other similar structures, in accordance with the requirements of these specifications and the lines and dimensions shown on the drawing or as indicated by the Engineer-in-charge. The work shall include all necessary sheeting, shorting bracing draining an pumping and the removal of all logs, stumps. grubs and other deleterious matter and obstructions necessary for placing the foundations, trimming bottoms of excavations, backfilling and clearing up the site and the disposal of all Surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, Curves and slopes.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due-regard to the safety of persons and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be as shown. on the drawings. unless the type of material encounted is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
5. Where waters is. met with in excavation due to stream flow, seepage springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, constructing diversion channels drainage channels, and other necessary work to keep the foundation trenches dry when so required and to protect green concrete/masonry against damage by erosion or sudden rising of water level. The method to be accepted in this regard and other details there of shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge, Approval of the Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality an safety of the work.
6. Pumping from the interior of any foundation enclosures shall be done in such manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during 'he placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose of bringing the foundation to level. If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.
8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall be required to take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.

9. Backfilling shall be done with approved material after concrete or masonry, is fully set and carried out in such a way as not to cause under thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm loose layers. Which shall be watered and compacted.
10. All the excavated materials shall be the property of the Government. Where the excavated material is directed to be used in the construction of embankment, it shall be directly deposited at the required locations.
11. All useful materials, not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 50 metres lead. Unsuitable and surplus materials not intended for use in any part of the road shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic metres for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer-in-charge. Excavation over increased width, cutting of slopes, shoring, shattering and planking shall be deemed as convenience for the Contractor in executing the work and shall not be measured and paid for separately.
13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including.
 1. Setting Out
 2. Construction of necessary shoring and bracing and their subsequent removal;
 3. Removal of all logs stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
 4. Foundation sealing, dewatering including pumping;
 5. Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads upto 100 metres;
 6. All labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.
14. Excavation shall be in hard murrum such as stiff heavy clay, hard shale or compact murrum requiring grafting tool or pick or both and shovel. Closely applied and gravel and rubble stone having maximum diameter in any one direction between 75 and 300 mm and soft conglomerate. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

Item No.17 Excavation in large boulders and soft rock by welding including shoring, strutting and dewatering as necessary and disposing of the excavated stuff as directed.

1. Excavation for structure shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls pipe culverts and other similar structures, in accordance with the requirements, of these specification and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall be include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, shrubs and other deleterious matter and obstruction necessary for the foundations trimming bottoms of excavation backfilling and clearing up to site disposal of all surplus materials.

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves slopes grade and sections as shown on the drawing or as directed by the Engineer-in-charges. The Contractor shall provide all labour, survey instruments and materials such as strings, page nails bamboos stones lime, mortar, and concrete etc. required in connection with the sitting out of works and the establishment of benchmark centre line stones and other marks 0and stakes as long as in the opinion of the Engineer-in-charges, they are required for the work.

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

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

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

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

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

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

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

10. All the excavation materials shall be the property of the Government. Where the excavation materials are to be used in the construction of embankment, it shall be directly deposited at the required location, within 100 metres lead.

11. All useful materials not intended for use in the work shall be stacked neatly on Government land as directed by the Engineer-in-charges within 100 metres lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charges.

12. Excavation for structure shall be measured in cubic metres for each class of materials encountered to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.

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

1. Setting out and fixing bench marks and centre line stones.

2. Construction of necessary shoring and bracing and their subsequent removal.

3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions for placing the foundation including trimming of bottoms of excavations:

4. Foundation sealing, dewatering including pumping.

5. Backfilling, clearing up the site and disposal of all surplus materials within all lifts and lead upto 100 metres.

6. All labour materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.

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

Item No.18 Providing & Casting in situ ordinary cement concrete m-150 mix and providing necessary in headers including shuttering, scaffolding, laying, vibrating, curing and finishing comp. without V - grooves.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.
2. In the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg. / cm².
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cubic metres in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for "bulking" shall be made as per I.S.: 2386 (Part - III).
4. Ingredients required for ordinary concrete containing one 50 Kg bag of cement of different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by Volume	Total quantity of dry aggregate by volume per 50 Kg. / of cement to be taken as per sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate.	Quantity of water per 50 Kg. of cement maximum.
1	2	3	4	5
Ordinary	Liters			Liters
M-100	1:3:6	300	Generally 1 : 2	34
M-150	1:2:4	220	for aggregate	32
M-200	1:1 ½ :	160	to coarse	30
M-250	3	100	aggregate by	27
M-350	1 : 1 : 2		volume but	
			subject to and	
			upper limit of 1	
			: 1 ½ and a	
			lower limit 1 : 3	

NOTE - The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of coarse aggregate becomes larger.

Example - For an average grading of fine aggregate (that is Zone II of I.S.: 383-1963) the proportions shall be 1:1.1/2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm. and 40 mm. respectively (after carrying out sieve analysis).

Note-2 A mix leaner than M.100 (1:3:6) may be used for non- structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregate
(i)	R.C.C. well curb, R.C.C. well staining and R.C.C. pipes	40 mm.
(ii)	R.C.C. well staining	63 mm
(iii)	Well cap or pipe cap; solid type pipes abutment and wing-walls, and their pipe caps	40 mm
(iv)	R.C.C. works in cross girders deck slab, wearing coats, kerb, light posts, blast walls, approach slab etc. and hollow type piers, abutment, wing-walls and their pier caps.	20 mm
(v)	R.C.C. bearings	20 mm
(vi)	For any other item of construction not covered by items (i) to (v)	As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement, whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.
9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large

enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 per cent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in- charge, concrete shall be deposited in horizontal layers to neither a compacted depth of nor more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.
17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. From work shall include all temporary or permanent forms required for forming the concrete together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories:
 - (1) Shuttering i.e., form work required for forming the concrete.
 - (2) Scaffolding i.e., form-work required for supporting shuttering.Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding shall be constructed of metal. Both shuttering and scaffolding shall be or substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings: All bolts and rivets shall be counter-sunk and well ground to provide a smooth, plane surface. Only steel formwork shall be used.
19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable comber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in- charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre stressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works:
21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The form work should take due account of the calculated amount of positive or negative camber so as to ensure

the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre stressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm cover to the finished concrete surface. Where it is intended to reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.
23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.
25. In the case of reinforced concrete work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of

consistency, which shall depend up on the nature of work and methods of vibration of concrete shall be determined by regular slump tests. Following slump shall be adopted for different types of works.

Sr. No.	Type of Work	Slumps	
		Where vibrators are used	Where vibrators are not used
(i)	Mass concrete in R.C.C. foundations, footings and retaining walls	10 mm to 25 mm	80 mm
(ii)	Beams, slabs and columns simply reinforced	25 mm to 40 mm	100 mm to 120 mm
(iii)	Thin R.C.C. section or section with congested steel.	40 mm to 50 mm	125 mm to 150 mm

25. Works strength tests shall be made in accordance with I.S.: 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete proud. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.
26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specifies strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall approved by he Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provide so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, Kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Assistant Engineer / Additional Assistant Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.
29. All necessary labour, materials equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

30. The payment will be made on cumt basis of the finished work.
31. The unit rate of concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all centers and forms required for the work.

Item No.19 Supplying & fixing reinforced concrete heavy duty non pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (to level or slope) of I.S. class NP3 (V) 1200 mm. with all lead

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type 1200mm dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be NP-3 type conforming to the requirements of I.S. 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP-3, NP-2, NP-1 pipes are used for R.C.C. pipes where testing of pipes. Where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various tests as per I.S. 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carrying out test at our factory sites.

We have experience of manufacturing of pipes of _____ years. The pipes supplied by us to M/s. _____ satisfy the requirement of I.S. 458.

Date: _____

Place: _____

Manufacturer's Sign: -

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in work they form a culvert with a smooth uniform invert: Any pipe found defective or damaged during laying be removed at the cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in ratio of 1:2 rammed with caulking irons: Before caulking the collar shall be so placed that its centre coincides with that of pipe and even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 mm wide. The jointed space shall be filled with cement mortar 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care

shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joints shall be kept covered and damp for at least four days.

5. RCC Pipes shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipe shall include the cost of pipe including loading unloading, handling storing laying in position and joining complete.
The payment shall be made on Rmt. basis for completed item as per item description or as directed.

Item No.20 Supplying & fixing reinforced concrete heavy duty non pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (to level or slope) of I.S. class NP3 (V) 900 mm. with all lead

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type 1200mm dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be NP-3 type conforming to the requirements of I.S. 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP-3, NP-2, NP-1 pipes are used for R.C.C. pipes where testing of pipes. Where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various tests as per I.S. 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carrying out test at our factory sites.

We have experience of manufacturing of pipes of _____ years. The pipes supplied by us to M/s. _____ satisfy the requirement of I.S. 458.

Date: _____

Place: _____

Manufacturer's Sign: -

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in work they form a culvert with a smooth uniform invert: Any pipe found defective or damaged during laying be removed at the cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in ratio of 1:2 rammed with caulking irons: Before caulking the collar shall be so placed that its centre coincides with that of pipe and even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 mm wide. The jointed space shall be filled with cement mortar 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care

shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joints shall be kept covered and damp for at least four days.

5. RCC Pipes shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipe shall include the cost of pipe including loading unloading, handling storing laying in position and joining complete.
The payment shall be made on Rmt. basis for completed item as per item description or as directed.

Item No.21 Providing and laying in position FE 500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings

1.0. GENERAL

This work shall consist of furnishing and placing coated, or uncoated or high strength deformed reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these specifications or as approved by the Engineer in charge.

2.0. MATERIAL

2.1. T.M.T. Bars

Reinforcements may be either T.M.T. tensile steel, [confirms to IS 1786-2008 bars](#). They may be uncoated or coated with epoxy or with approved protective coatings.

2.2. T.M.T. bars reinforcement for R.C.C. work shall conform IS 432 (Part II) 1982 (Reaffirmed 1995) and shall be of tested quality. It shall also comply with relevant part of IS 456-2000.

2.3. All reinforcement shall be clean and free from dirt, paint, grease or oil, all scale or loose or thick rust at the time of placing.

2.4. All steel shall be procured from original producers no re-rolled steel shall be incorporated in the work.

2.5. Only new steel shall be delivered to the site every bar shall be inspected before placing to its position and defective brittle or burnt bar shall be discarded cracked ends of bars shall be discarded.

3.0. Pitch

3.1. Distance between bars shall be as specified in drawings and as directed by the Engineer in charge all bars shall be placed at an accurate distance from each other and shall be bind tightly to maintain the desired pitch Suitable means shall be provided for holding bars securely in position.

4.0. Binding wire

4.1. Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge) diameter and shall conform IS 280-2006.

4.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from dirt, paint, grease or oil, oil scale or loose or thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding.

4.3. Only new binding wire shall be delivered to the site all binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded.

5.0. PROTECTION OF REINFORCEMENT

5.1. Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as

directed by the Engineer. Reinforcements shall be stored on bricks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

- 5.2. Portions of uncoated reinforcing steel and dowels projecting from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency, of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

6.0. Workmanship

- 6.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed by The Engineer in charge.

- 6.2. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawing

7.0. BENDING OF REINFORCEMENT

- 7.1. Bar bend g schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

- 7.2. Reinforcing steel shall conform to the dimensions and shapes given in the approved bar bending Schedules.

- 7.3. Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape.

Bars shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before being used on work and shall not be heated to facilitate straightening.

8.0. PLACING OF REINFORCEMENT

- 8.1. The reinforcement cage should generally be fabricated in the yard at ground level, and then shifted and placed in position. The reinforcement shall be placed strictly, in accordance with the drawings and shall be assembled in position, only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

- 8.2. Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

- 8.3. Bars shall be kept in position usually by the following methods:

In case of beam an slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to Satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

- 8.4. In case of dowels for Columns and walls the vertical reinforcement shall be kept in position by means of timber templates with slots in them accurately, or with

cover blocks tied to the reinforcement timber templates shall be removed after the concreting has progressed up to a level just below their location.

- 8.5. Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals. The minimum diameter of spacer bars shall be 12 mm or: equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be, allowed to sag between supports.
- 8.6. Necessary stays, blocks, metal chairs, spacers, metal hangers supporting wires etc, or other subsidiary, reinforcement shall be provided to fix the reinforcements firmly in its correct position.
- 8.7. Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.
- 8.8. Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose.
- 8.9. Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

9.0. Lapping

- 9.1. All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing; will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1 1/4 times the maximum size of coarse aggregate, whichever is greater, If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

10.0. Welding

- 10.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.
- 10.2. While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15}$$

is 0.4 or less.

- 10.3. The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer
- 10.4. Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, operated by hand or power to attain proper radius of bends. Bars shall not be bend or straightened in a manner that will injure the material. Bars bent during transport or handling shall

be straightened before being used in the work. Bars shall not be heated to facilitate bending

- 10.5.** Unless otherwise specified a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times of the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any spalling of the concrete
- 10.6.** All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work All devices used for positioning shall be of non-corrodible material wooden and metal supports shall not extend to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete, Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be added and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout
- 10.7.** Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm in such a manner that they do not slip over at the time of fixing and concreting
As far possible bars of full length shall be used in case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When practicable overlapping bars shall not touch each other, but be kept apart by 25 mm Where no feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moments is maximum.
- 10.8.** Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standard threads Steel for coupling shall conform to IS 226
- 10.9.** When permitted or specified on the drawings joints of reinforcement bars shall butt-welded so as to transmit their full stresses Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded Only electric arc welding using a process which excludes air from the molten metal and conforms to any or

other special provisions for the work shall be accepted Suitable means shall be provided for holding bars securely in position during welding It shall be ensured that no voids are left in welding and when welding is done in two or three stages previous surface shall be cleaned properly Ends of bars shall be cleaned of all loose scale rust stages paint and other foreign matter before welding Only competent welders shall be employed on the work. The M S electrodes used for welding shall conform IS 814 Welded pieces of reinforcement shall be tested. Specimen shall be taken form the actual site and their number shall frequency to test shall be as directed by the Engineer in charge

11.0 MODE OF MEASUREMENTS & PAYMENT

- 11.1.** For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below

Sr. No	Diameter of steel	weight of steel per running meter	Sr. No	Diameter of steel	weight of steel per running meter
1	6 mm	0.22 Kg / Rmt	8	20 mm	2.47 Kg / Rmt
2	8 mm	0.39 Kg / Rmt	9	22 mm	2.98 Kg / Rmt
3	10 mm	0.62 Kg / Rmt	10	25 mm	3.85 Kg / Rmt
4	12 mm	0.89 Kg / Rmt	11	28 mm	4.83 Kg / Rmt
5	14 mm	1.21 Kg / Rmt	12	32 mm	6.31 Kg / Rmt
6	16 mm	1.58 Kg / Rmt	13	36 mm	7.99 Kg / Rmt
7	18 mm	2.00 Kg / Rmt	14	40mm	9.86 Kg / Rmt

- 11.1.** Excess consumption over 5% will be charged at penal rate.

- 11.2.** Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the basis of IS: 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement..

- 11.3.** The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit Rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

- 11.4.** The rate shall be for a unit of **one M.T.**

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Item No.22 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. That Demolition of R.C.C. work is to be done .

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 cement concrete shall be measured under this item.

Specification for deduction for voids, openings etc. shall be on same basis as that employed for construction of work.

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

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

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

Item No.23 Providing and fixing of flood gauge in C.C. 1:2:4 with M.S. Channels C Type of size 125 X 65 mm with web thick ness 5mm thick 1.50 mt. long including the cutting the channels bending one edge for hold fast including painting with oil paint of approved brand manufacture three with one coat of primer and marking Numbering lettering etc comp by using radium strips at causeway deep on road side As per Direction(Including cost of C- Channels & Cement)

The flood gauge is to be fixed as per I.R.C. Standard Specification having 100mm. x 100 mm. x 6mm. size, M.S. Angle having height equal to 1.50 Mt. It shall be fixed in C.C. 1:2:4 as per drawing. The painting shall be done applying one primer coat & three coats of oil paint as per requirement & as per drawing using approved paints including lettering for flood gauge marking as per I.R.C. std. & drawings.

The work shall be carried out and materials used shall be to the entire satisfaction of the Engineer-in-charge.

The rate inclusive of all materials and labour with carriage, fixing, panting etc. complete as per drawing and direction of the Engineer-in-charge.

The measurement & Rate paid shall be on Number basis of flood gauge fixed.

Item No.24 **Informatrory sign :-** Providing and fixing sing board made out of 2mm aluminium sheet size 80 x 60 cms rectangle as per design of IRC-67-1977 pre treated with phospheting process & acid teching coated with one coat of epoxyprimer and two coat of best quality poxy paint reflectorised with reto reflective sheeting as per latest M.O.S.T. Specifications 3.10 m long stand postand frame fabricated from suitable size iron angle of 35 X 35 X 3mm 75 X 75 X 6 mm as required painted with best quality poxy coating in black and white bends the details of symbols for each board shall details of symbol of eachboard shall be as per the instruction of engineer in charge the fixing at site shall be in 1:2:4 CCblock of size 45 X 45 X 60 cms for each leg including excavation curing tec complete under the of engineer in charge (A) Engineer Grade

General

801.1.1.The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs,-IRC: 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

801.2.2.The signs shall be either refectories or non-reflectarised as shown on the drawings or as directed by the Engineer. When they are of refectories type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminum sheeting as per these Specifications.

801.2.2.In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded. well on the base sheeting as directed by the Engineer.

Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

Concrete : Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer. fixing at site shall be in 1:2:4 C.C. block of size 45x45x60cms. for each leg. including excavation curing complete under the supervision of Engineer-in-Charge.

801.2.2.Reinforcing steel : Reinforcing steel shall conform to the requirement of IS:1786 unless otherwise shown on the drawing. 3.1m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50x50x5mm, 75x75x6mm as required **Bolts, nuts, washers:** High strength bolts shall conform to IS : 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

801.2.2.Plates and supports : Plates and support sections for the, sign posts shall conform -to IS: 226 and IS: 2062 or any other relevant IS Specifications.

801.2.2.Aluminum: Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS : 736-Material designation 24345 or 1900. 2mm alluminium sheet size 180x120cms rectangle as per the design of IRC-67-1977 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

801.2.2. In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings.

Traffic Signs Having Retro-reflective Sheeting

801.2.2. General requirements: The retro-reflective sheeting used on the sign shall consist of the white or colored sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show color fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

801.2.2. High intensity grade sheeting : This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E : 810) as indicated in Table 800-1.

TABLE 800-1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle Red (in degrees)	White	Yellow	Orange	Green	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

801.2.2. 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 reflecting system. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard : E-810) as indicated in Table 800-2.

TABLE 900-2. ACCEPTABLE MINIMUM COEFFICIENT OF RETROREFLECTION FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle In degree	Entrance angle in degree	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	4.5	7.5 2.0
0.5	+30	15		13	4.0	2.2	3.0 0.8

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro-reflection indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

801.3.4.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.

801.2.2.For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

801.2.2.Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2 or 801.3.3 as applicable), except those in black which shall be of non-reflective sheeting.

801.2.2.Colour: Unless otherwise specified, the general colour schbm6 shall be as stipulated in IS 5 "Colour for Ready Mixed Paints", viz.

Blue	-	is	ColourNo. 166: French Blue
Red	-	is	ColourNo. 537: Signal Red
Green	-	is	ColourNo. 284: India Green
Orange	-	IS	ColourNo. 591: Deep Orange.

The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8.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 free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure sensitive adhesive sheeting, the sheeting shall be - applied in accordance with the manufacturer's Specifications. Sheetting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

Refurbishment: Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminum backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10. Fabrication

Surface to be refectories shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale,/dust removed to obtain a smooth plain surface before the application of retro reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

Complete sheets of the material shall be used. on the signs except where it is unavoidable; at splices, sheeting 'with pressure sensitive adhesives shall be overlapped not lea than 5 mm. Sheetting with heat-activated adhesives may be spliced

with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only 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.

801.3.11. Warranty and durability : The Contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade, and submit the same to the Engineer. In addition, a seven year and a five year 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 meets 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 discoloration, cracking, blistering or dimensional change and shall not have less than 50 per. cent of the specified minimum reflective *intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

801.4. Installation

801.4.1. 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 up to 0.9 sq. in. 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 galvanized 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.

801.4.2. All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly discaled, 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.

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 GI posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

Measurements for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed,

801.6. 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 seven 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 payments 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.25 Providing and fixing ordinary Kilometer stone of approved hard stone as per I.R.C. type design in C.C. 1:4:8 including painting and lettering etc. complete

1. Kilometer stone shall be of approved quality and shall be either black Rajula stone or of precast 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C. - 8 (Type design for Highway kilometer stones). The fixing of K.M. stone shall be carried out in ordinary concrete of grade specified in the item using hand broken metal field metal or gravel. The measurement for payment shall be made per No. of K.M. stone fixed in position.
3. Unit rate for kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.
The Payment shall be made on No. basis for complete item.

Item No.26 Providing and fixing Hectometer as per I.R.C. type design including painting, lettering etc. complete.(ii) Fixing in C.C. 1:5:10

The work shall be carried out as per the item of ordinary kilometer stone except that the size of hectometer stone shall be smaller than that of ordinary kilometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats or H.B. metal 40mm size. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone as per item No. . Rate includes all labour and curing etc. necessary for concrete.

The Payment shall be made on No. basis for complete item.

Item No.27 Providing and fixing guard stone as per I.R.C. type design including white washing etc. complete.(i) Fixing in Earth

- 1** The guard stone shall be of approved quality and shall be either Rajula stone or of Precast C.C.M-100 R.C.C.and 20 x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cm. shall be chisel dressed on all sides. The size shape and dimensions of the guard stones shall be exact and shall be nearly dressed and finished.
- 2** The guard stone shall be fixed in position as directed by the Engineer-in-charge in earth if the guard stone shall be fixed in wearing coat the equivalent volume covered by the guard stone shall be deducted from the gross measured quantity of wearing coat. The exposed part of the guard stones shall be given three coats of white wash. Any excavation necessary for fixing of the guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per number of guard stone fixed in position.
- 3** Unit rate of guard stone includes the cost of all materials, labours, tools, fixing and white washing as directed by the Engineer-in-charge.
- 4** In case of Deep / Causeway the guard stone shall be fixed in masonry of head wall as directed by the Engineer-in-charge.

The Payment shall be made on No. basis for complete item.

Item No.28 Providing and fixing indicator stone fixing in earth of approved stone as per I.R.C. type design in C.C. 1:4:8 including white washing etc. complete.

- 1.0** Indicator stones shall be of approved quality and of the size 20cm. x 20cm. its length shall not be less than 80cms. The top, 38cm. shall be chisel dressed on all sides. The size shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stone shall be done by the contractor at his own cost. The measurement for payment shall be per number of indicator stone fixed in fixed in position.
- 2.0** Unit rate indicator stone includes the cost of all materials, labour, tools, fixing and white washing as directed by the Engineer-in-charge.

Item No.29 Village name/ Bump Ahead sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm 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)...

General

801.1.1.The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs,-IRC: 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

801.2.2.The signs shall be either reflectorised or non-reflectorised as shown on the drawings or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminum sheeting as per these Specifications.

801.2.2.In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded. well on the base sheeting as directed by the Engineer.

Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

Concrete : Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer. fixing at site shall be in 1:2:4 C.C. block of size 45x45x60cms. for each leg. including excavation curing complete under the supervision of Engineer-in-Charge.

801.2.2.**Reinforcing steel** : Reinforcing steel shall conform to the requirement of IS:1786 unless otherwise shown on the drawing. 3.1m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50x50x5mm, 75x75x6mm as required **Bolts, nuts, washers**: High strength bolts shall conform to IS : 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

801.2.2.**Plates and supports** : Plates and support sections for the, sign posts shall conform -to IS: 226 and IS: 2062 or any other relevant IS Specifications.

801.2.2.**Aluminum**: Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminum alloy conforming to IS : 736-Material designation 24345 or 1900. 2mm aluminium sheet size 180x120cms rectangle as per the design of IRC-67-1977 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

801.2.2. In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings.

Traffic Signs Having Retro-reflective Sheeting

801.2.2. General requirements: The retro-reflective sheeting used on the sign shall consist of the white or colored sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show color fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

801.2.2. High intensity grade sheeting : This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E : 810) as indicated in Table 800-1.

TABLE 800-1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle Red (in degrees)	White	Yellow	Orange	Green	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

801.2.2. 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 reflecting system. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard : E-810) as indicated in Table 800-2.

TABLE 900-2. ACCEPTABLE MINIMUM COEFFICIENT OF RETROREFLECTION FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle In degree	Entrance angle in degree	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	4.5	7.5 2.0
0.5	+30	15		13	4.0	2.2	3.0 0.8

When totally wet, the sheeting shall not show less than 90 per cent of the values, of retro-reflection indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

801.3.4.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.

801.2.2.For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

801.2.2.Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2 or 801.3.3 as applicable), except those in black which shall be of non-reflective sheeting.

801.2.2.Colour: Unless otherwise specified, the general colour schbm6 shall be as stipulated in IS 5 "Colour for Ready Mixed Paints", viz.

Blue	-	is	ColourNo. 166: French Blue
Red	-	is	ColourNo. 537: Signal Red
Green	-	is	ColourNo. 284: India Green
Orange	-	IS	ColourNo. 591: Deep Orange.

The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8.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 free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure sensitive adhesive sheeting, the sheeting shall be - applied in accordance with the manufacturer's Specifications. Sheetting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

Refurbishment: Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminum backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10. Fabrication

Surface to be refectories shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale,/dust removed to obtain a smooth plain surface before the application of retro reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

Complete sheets of the material shall be used. on the signs except where it is unavoidable; at splices, sheeting 'with pressure sensitive adhesives shall be overlapped not lea than 5 mm. Sheetting with heat-activated adhesives may be spliced

with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only 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.

801.3.11. Warranty and durability : The Contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade, and submit the same to the Engineer. In addition, a seven year and a five year 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 meets 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 discoloration, cracking, blistering or dimensional change and shall not have less than 50 per. cent of the specified minimum reflective *intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

801.4. Installation

801.4.1. 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 up to 0.9 sq. in. 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 galvanized 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.

801.4.2. All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly discaled, 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.

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 GI posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

Measurements for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed,

801.6. 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 seven 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 payments 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.30 Hazard Marker Sign :-Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

1.0 SCOPE :

The work shall consist of providing and fixing in C.C. 1:2:4 (45x45x60cm. size) the road sign boards as per specification as under and as directed by Engineer-in-charge.

2.0 MATERIALS:

The boards shall be made from 2mm alluminium sheet. The sheet shall be of good quality approved by Engineer-in-charge. Stand post and frames should be made of M.S. angle of 50x50x5mm size. Epoxy paint and epoxy primer shall be of approved quality and shade as approved by Engineer-in-charge. The retro-reflective sheeting of Engineer-in-charge shall be encapsulated lens type.

3.0 TRAFFIC SIGNS HAVING RETROREFLECTIVE SHEETING:

4.0 GENERAL REQUIREMENTS:

The retro-reflective sheeting used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has to property of retro-reflection 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 sheeeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these testes shall be obtained from a reputed laboratory by the manufacturer of the sheeting The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of high intensity Grade with encapsualted lens/micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierchy and importance of the road.

5.0 ENGINEERING GRADE SHEETING :

This sheeting shall be enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth. flexible, transparent, water-proof plastic, resulting in a none exposed lens optical reflecting system. 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-81) as indicated in Table 800-2)

TABLE 800-2

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTION FOR ENGINEERING GRADE SHEETING

CANDEL AS PER LUX PER SQUARE METRE

Observation Angle (in Degress.)	Entrance Angle (in degress)	White	Yellow	Orange	Green	Red	Blue
0.2°	4	70	50	2.5	9.0	14.5	4.00
0.2°	30	30	22	7.0	3.5	6.0	1.7
0.5°	-4	30	25	13.5	4.5	7.5	2.0
0.5°	-30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall bet show less than 90% of the values of retro reflection indicated in Table 800-1(a) and 800-1 (b) respectively. At the end of 7 years, the sheeting shall retain at least 80% of its original retro reflectances except for orange colour.

6.0 Message (legends, letters, numerals etc.) and borders shall either be screen printed or of cut-outs screen printing shall be processes 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 bounded with the sheeting in manner specified by the manufacturer.

7.0 For Screen printed transparent coloured areas on white sheeting the coefficient of retro-reflection shall not be less than 50% (Fifty) of the value of corresponding colour in Table 800.1(a), 800.1(b) and 800-2 as applicable.

8.0 Cut of 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.

9.0 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 colour shall be durable and uniform in acceptance hue when viewed in day light or under normal headlights at night.

10.0 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 clear surface. or a tack free adhesive activated by heat, applied in a heat vacuum applicator in a manner recommended by the sheeting manufacturer. The sheeting shall be protected 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 place by use of sharp instrument. In case of pressure sensitive adhesive sheeting the sheeting shall be applied in accordance with the manufacturer's instructions.

11. 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 the type of material used

for the sign and should thoroughly bond with that material. Alternatively, the aluminium blank shall be re-cycled to a finished condition and new sheeting's put on in an approved manner.

12.0 FABRICATION

12.0.1 Surface to be rectified shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable divide 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.

12.0.2 Complete sheets or the material shall be used on the sign except where it is unavoidable, at slices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5mm sheeting with heat activated adhesives may be spliced with an overlap not less than 5mm or butted with a gap not exceeding 0.75mm. Where screen printing with transparent colours is proposed, only butt joining shall be used. The materials 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.

13.0 WARRANTY AND DURABILITY:

For each lot of sheeting's procured the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheeting of high intensity grade and 5 years warranty for the Engineering grade and submit the same to the Engineer. In addition, a 7 years and 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 letter/legends and their pending to the retro reflective sheeting shall be obtained from the contractor/supplier and passed on to the Engineer. 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 requirement and carry the stipulated warranty. All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/ restoration of the retro-reflective efficiency.

14.0 INSTALLATION:

14.0.1 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 up to 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 galvanized iron (G.I.) Posts end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specification as specified.

14.0.2 All Components of signs and supports, other than the reflective portion and G.I. Posts shall be thoroughly descaled cleaned, primed 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.

14.0.3 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.

MEASUREMENT FOR PAYMENT:

The measurement for standard Stop sign boards shall be in numbers of different types of sign supplied and fixed. Direction and place identification signs, also shall be measured in numbers of different types of sign supplied and fixed.

The contract unit rate shall be payment in full for the cost 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 seven 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 payments 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.31 **Cautionary Warning Sign :-**Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

2.0 SCOPE :

The work shall consist of providing and fixing in C.C. 1:2:4 (45x45x60cm. size) the road sign boards as per specification as under and as directed by Engineer-in-charge.

2.0 MATERIALS:

The boards shall be made from 2mm alluminium sheet. The sheet shall be of good quality approved by Engineer-in-charge. Stand post and frames should be made of M.S. angle of 50x50x5mm size. Epoxy paint and epoxy primer shall be of approved quality and shade as approved by Engineer-in-charge. The retro-reflective sheeting of Engineer-in-charge shall be encapsulated lens type.

3.0 TRAFFIC SIGNS HAVING RETROREFLECTIVE SHEETING:

4.0 GENERAL REQUIREMENTS:

The retro-reflective sheeting used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has to property of retro-reflection 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 sheeeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these testes shall be obtained from a reputed laboratory by the manufacturer of the sheeting The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of high intensity Grade with encapsualted lens/micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierchy and importance of the road.

5.0 ENGINEERING GRADE SHEETING :

This sheeting shall be enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth. flexible, transparent, water-proof plastic, resulting in a none exposed lens optical reflecting system. 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-81) as indicated in Table 800-2)

TABLE 800-2

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTION FOR ENGINEERING GRADE SHEETING

CANDEL AS PER LUX PER SQUARE METRE

Observation Angle (in Degress.)	Entrance Angle (in degress)	White	Yellow	Orange	Green	Red	Blue
0.2°	4	70	50	2.5	9.0	14.5	4.00
0.2°	30	30	22	7.0	3.5	6.0	1.7
0.5°	-4	30	25	13.5	4.5	7.5	2.0
0.5°	-30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall bet show less than 90% of the values of retro reflection indicated in Table 800-1(a) and 800-1 (b) respectively. At the end of 7 years, the sheeting shall retain at least 80% of its original retro reflectances except for orange colour.

6.0 Message (legends, letters, numerals etc.) and borders shall either be screen printed or of cut-outs screen printing shall be processes 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 bounded with the sheeting in manner specified by the manufacturer.

7.0 For Screen printed transparent coloured areas on white sheeting the coefficient of retro-reflection shall not be less than 50% (Fifty) of the value of corresponding colour in Table 800.1(a), 800.1(b) and 800-2 as applicable.

8.0 Cut of 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.

9.0 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 colour shall be durable and uniform in acceptance hue when viewed in day light or under normal headlights at night.

11.0 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 clear surface. or a tack free adhesive activated by heat, applied in a heat vacuum applicator in a manner recommended by the sheeting manufacturer. The sheeting shall be protected 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 place by use of sharp instrument. In case of pressure sensitive adhesive sheeting the sheeting shall be applied in accordance with the manufacturer's instructions.

11. 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 the type of material used

for the sign and should thoroughly bond with that material Alternatively, the aluminium blank shall be re-cycled to a finished condition and new sheeting's put on in an approved manner.

12.0 FABRICATION

12.0.1 Surface to be rectified shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable divide 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.

12.0.2 Complete sheets or the material shall be used on the sign except where it is unavoidable, at joints, sheeting with pressure sensitive adhesives shall be overlapped not less than 5mm sheeting with heat activated adhesives may be spliced with an overlap not less than 5mm or butted with a gap not exceeding 0.75mm. Where screen printing with transparent colours is proposed, only butt joining shall be used. The materials 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.

15.0 WARRANTY AND DURABILITY:

For each lot of sheeting's procured the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheeting of high intensity grade and 5 years warranty for the Engineering grade and submit the same to the Engineer. In addition, a 7 years and 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 letter/legends and their pending to the retro reflective sheeting shall be obtained from the contractor/supplier and passed on to the Engineer. 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 requirement and carry the stipulated warranty. All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/ restoration of the retro-reflective efficiency.

16.0 INSTALLATION:

14.0.1 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 up to 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 galvanized iron (G.I.) Posts end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specification as specified.

14.0.2 All Components of signs and supports, other than the reflective portion and G.I. Posts shall be thoroughly descaled cleaned, primed 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.

14.0.3 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.

MEASUREMENT FOR PAYMENT:

The measurement for standard Stop sign boards shall be in numbers of different types of sign supplied and fixed. Direction and place identification signs, also shall be measured in numbers of different types of sign supplied and fixed.

The contract unit rate shall be payment in full for the cost 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 seven 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 payments 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.32 STOP Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 cms Octagone as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with Micro Prismatic Grade retro reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting

3.0 SCOPE :

The work shall consist of providing and fixing in C.C. 1:2:4 (45x45x60cm. size) the road sign boards as per specification as under and as directed by Engineer-in-charge.

2.0 MATERIALS:

The boards shall be made from 2mm alluminium sheet. The sheet shall be of good quality approved by Engineer-in-charge. Stand post and frames should be made of M.S. angle of 50x50x5mm size. Epoxy paint and epoxy primer shall be of approved quality and shade as approved by Engineer-in-charge. The retro-reflective sheeting of Engineer-in-charge shall be encapsulated lens type.

3.0 TRAFFIC SIGNS HAVING RETROREFLECTIVE SHEETING:

4.0 GENERAL REQUIREMENTS:

The retro-reflective sheeting used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has to property of retro-reflection 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 sheeeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these testes shall be obtained from a reputed laboratory by the manufacturer of the sheeting The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of high intensity Grade with encapsualted lens/micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierchy and importance of the road.

5.0 ENGINEERING GRADE SHEETING :

This sheeting shall be enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth. flexible, transparent, water-proof plastic, resulting in a none exposed lens optical reflecting system. 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-81) as indicated in Table 800-2)

TABLE 800-2

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTION FOR ENGINEERING
GRADE SHEETING
CANDEL AS PER LUX PER SQUARE METRE

Observation Angle (in Degress.)	Entrance Angle (in degress)	White	Yellow	Orange	Green	Red	Blue
0.2°	4	70	50	2.5	9.0	14.5	4.00
0.2°	30	30	22	7.0	3.5	6.0	1.7
0.5°	-4	30	25	13.5	4.5	7.5	2.0
0.5°	-30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall bet show less than 90% of the values of retro reflection indicated in Table 800-1(a) and 800-1 (b) respectively. At the end of 7 years, the sheeting shall retain at least 80% of its original retro reflectances except for orange colour.

6.0 Message (legends, letters, numerals etc.) and borders shall either be screen printed or of cut-outs screen printing shall be processes 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 bounded with the sheeting in manner specified by the manufacturer.

7.0 For Screen printed transparent coloured areas on white sheeting the coefficient of retro-reflection shall not be less than 50% (Fifty) of the value of corresponding colour in Table 800.1(a), 800.1(b) and 800-2 as applicable.

8.0 Cut of 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.

9.0 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 colour shall be durable and uniform in acceptance hue when viewed in day light or under normal headlights at night.

12.0 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 clear surface. or a tack free adhesive activated by heat, applied in a heat vacuum applicator in a manner recommended by the sheeting manufacturer. The sheeting shall be protected 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 place by use of sharp instrument. In case of pressure sensitive adhesive sheeting the sheeting shall be applied in accordance with the manufacturer's instructions.

11. REFURBISHMENT:

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aluminium blank shall be re-cycled to a finished condition and new sheeting's put on in an approved manner.

12.0 FABRICATION

12.0.1 Surface to be rectified shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable divide 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.

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17.0 WARRANTY AND DURABILITY:

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18.0 INSTALLATION:

14.0.1 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 up to 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 galvanized iron (G.I.) Posts end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specification as specified.

14.0.2 All Components of signs and supports, other than the reflective portion and G.I. Posts shall be thoroughly descaled cleaned, primed with two coats of epoxy paint.

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14.0.3 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.

MEASUREMENT FOR PAYMENT:

The measurement for standard Stop sign boards shall be in numbers of difference types of sign supplied and fixed. Direction and place identification signs, also shall be measured in numbers of different types of sign supplied and fixed.

The contract unit rate shall be payment in full for the cost making the road sign including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

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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.34 Providing and fixing of typical informatory sign board with logo as per MORD specifications and drawing . Three MS Plates of 1.6 mm thick , top and middle plate duly welded with MS flat iron 25 x 5mm size on back on edges. The lower plate will be welded with MS angle iron frame of 25mm x 25mm. The Angle iron frame of the lower most plate and flat iron frame of middle plate will be welded 2 nos. 75mm x 75mm of 12 SWG sheet tubes posts duly embedded in cement concrete M-15 grade block of 450mm x 450mm x 600mm, 600mm below ground level. The top most dimond plate will be welded to middle plate by 47mm x 47mm of 12 SWG steel plate tube. All M.S. will be stove enameled on both sides. Lettering and printing arrows, border etc. will be painted with ready mixed synthetic enamel paint of superior quality in required shade and colour. All sections of framed posts and steel tubes will be painted with primer and two coats of epoxy pains as per drawing Clause 1701 and Annexure 1700.1

ATTACHED SEPARATELY HERE

Deputy Executive Engineer
Panchayat (R&B) Sub Division
Jamnagar.

Executive Engineer
Panchayat (R&B) Division
Jamnagar.