

Item No.	Description of Item	Item No/Page No. of corresponding applicable Specification Booklet.
1	Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, saplings and trees girth upto 300mm removal of stumps of trees cut earlier and disposal of unserviceable materials (C) By mechanical means in area of light jungle	As per A Separate Sheet
58	Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause 811	As per A Separate Sheet

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-:: SPECIFICATIONS ::-

Item No. :- 1

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

501 CLEARING AND GRUBBING

201.1 Scope

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

201.2 Preservation of Property / Amenities

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

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

201.3 Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the work. If the area has thick vegetation/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. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

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

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

201.4 Disposal of Materials

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

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lifts and upto a lead of 1000 m.

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

201.5 Measurements for Payment

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

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

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

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

Rates

201.6.1. 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 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lifts and upto a lead of 1000 m.

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

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

Item No. :- 2

Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. 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.

2.0. Mode of measurements and payment

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

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

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

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

Item No. :- 3

Providing and casting in situ controlled cement concrete M-250 for Kerb/ kerb blocks including formwork curing and finishing, complete.

1.0. 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. Graded stone aggregate 20 mm nominal size shall conform to M-12.

2.0. General

2.1. The concrete mix is not required to be designed by preliminary testes. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by volume concrete work shall have exposed concrete surface or as specified in the item

2.2. The designation ordinary M-100, M-150m M-200, M-250 specified as per I.S. correspond approximately to 1:3:6, 1:2:4, 1:1.1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively

2.3. The ingredients required for ordinary concrete containing one beg of cement of 50 kg. by weight (0.0342 Cu M.) for different proportions of mix shall be as under:

Grade of concrete	Total quantity of dry aggregate by volume per 50 kgs. of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kgs. of cement maximum
M-100 (1:3:6)	300 Liters	Generally 1:2 for fine aggregate to coarse aggregate by volume 160 but subject to an upper limit of 1:1.1/2 and lower limit	34 Liters
M-150 (1:2:4)	220 Liters		32 Liters
200 (1:1.1/2:3)			30 Liters
M-250 (1:1:2)	100 Liters		1:3 27 Liters

2.4. The water cement ratios shall not be more than specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be met eased to overcome the difficulties of placements and compaction so that the water-cement ratio specified in the table is not exceeded.

2.5. Workability of the concrete shall be controlled by maintaining a water -cement-ratio that is found to give a concrete mix which is just sufficient wet to be placed and compacted without difficulty with the means available.

2.6. The maximum size of coarse aggregate shall be as large as possible within the limits specified but in no case greater than one forth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

2.7. For reinforced concrete work; coarse aggregates having a nominal size of 20 mm. are generally considered satisfactory.

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

2.9. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important, and the nominal maximum size may some times be as great as or greater than the minimum cover.

2.10. Admixture maybe used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time neither the compressive strength of concrete is reduced not are other requisite qualities of concrete and steel impaired by the use of such admixtures.

3.0. Workmanship

Proportioning : Proportioning shall be done by volume, except which shall be measured in terms of bags of 50 kg. weight, the volume of one such bag being taken as 0.0342 cu. meter

Boxes of suitable size shall be used for measuring sand aggregate. The size of boxes (internal) shall be 35 x 25 cms. and 40 cms deep while measuring the aggregate and sand the boxes shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made.

3.2. Mixing :

3.2.1. For all work, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the claim of the mechanical mixer while it is continuously running. After half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

3.2.2. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Specified quantity of water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

3.2.3. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer in-charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

3.3. Consistency:

3.3.1. The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump tests in accordance with I.S. 1199-193. The slump of 10 mm. to 25 mm shall be adopted when vibrators are used and 80 mm. when vibrators are not used.

3.4. Inspection:

3.4.1. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men machinery materials and for results obtained immediately before concreting all forms shall be thoroughly cleaned.

3.4.2. Centering design and its erection shall be got approved from the engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile 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 kapachi or metal pieces shall not be used for this purpose.

3.5. Transporting and laying:

3.5.1. The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water dust, snow or

ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the engineer-in-charge has been obtained.

3.5.2. Concreting shall proceed continuously over the area between construction joints. Fresh concrete proper contraction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

3.5.3. Unless otherwise agreed to by the Engineer-in-charge concrete shall be dropped in to place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all lateness shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first 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.

3.5.4. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the even of breakdowns. Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

3.6. Curing:

Immediately after compaction, concrete weather including rain, running water, shocks, vibration, traffic, rapid temperature charges, frost and drying out process. It shall be covered with wet sacking has Sian or other similar absorbent material approved, soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

3.7. Sampling and testing of concrete:

3.7.1. Samples from fresh concrete shall be taken as per I.S. 1199-1959 and cubes shall be made, cured and tested at 7 days and 28 days as per requirements in accordance with I.S. 526-1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work.	No of samples	Quantity of concrete in the works	No of samples
No of samples	1	16-30 cmt	3
6.15 cmt.	2	31-50 cmt.	4
51 and above	4+	one additional for each additional 50 mm. or part thereof.	

Note : At least one sample shall be taken from each shift, Ten test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting as per above frequency. The number of

specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

3.7.2. The average of the group of cubes cast for each day shall not be less than the specified cube strength of 150 K/g Cm² at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the Proportions given for a particular grade shall not, however be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

3.8. Stripping:

3.8.1. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time of removal of form work, 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. In normal circumstances (generally where temperatures are above 20°C) and where ordinary concrete is used, forms may be struck after expiry of periods specified in item No.9.1 (A) for respective item of form work.

3.8.2. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soles and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal tiles are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

3.8.3. Immediately after the removal of forms, all exposed bolts etc. 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 tiles 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 proportions used in the grade of concrete that is being furnished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which are pointed shall be kept moist for a period of 24 hours. If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of structure affected.

4.0. Mode of Measurement & Payment

4.1. The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for (a) Ends of dissimilar materials such as joints, beams, posts, girders, gables, purling trusses, corbels and steps etc., up to 500 Sq. Cm. in section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate excludes the cost of form work.

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

Item No. :- 4

Providing and Fixing in position FE 500/500D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings. (A) R.C.C. Kerb. (B) R.C.C. Footpath. (C) R.C.C. Approach Slab. (D) Wearing coat.

2.0 MATERIAL

2.1 TMT Bars / CRS Steel

Reinforcements may be either E.M.T. tensile steel, high strength deformed bars. They may be uncoated or coated with epoxy or with approved protective coatings.

2.2 T.M.T. bars reinforcement for RCC work shall conform IS 432 (Part II) 1966 and shall be of tested quality. It shall also comply with relevant part of IS 456-1966.

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 laced 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 280-1972

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 be placed between the bars and formwork subject to Satisfactory evidence that th 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 bee, 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 hled 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 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 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 bent 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 spitting 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 bars 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 lapped 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 threads for coupling shall conform to IS : 225.

10.9 When permitted or specified on the drawings joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points 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, stains, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to IS : 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number shall be 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	40 mm	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 tones 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.

11.4 The rate shall be for a unit of **One MT.**

Item No. :- 5

Painting two coats after filling the surface with synthetic enamel paint in all shades on new plastered concrete surfaces

1.0. Materials

1.1. Ready mixed the black Japan paint shall conform to I.S. 341-1952. Workmanship The letters, figures and concrete surface shall be to the heights and widths as per approved drawings or as directed. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves,

3.0. Mode of measurements and payment Letters, figures and similar items etc. stops, commas, hyphens and the like shall be deemed to be included in the item. 9 3.2.

3.1. The rate per cm. height of letter shall hold good irrespective of width of the letters of figures or the thickness of the lettering.

3.2. The rate shall be for a unit of per letter cm. height.

Item No. :- 6

Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. layers not exceeding 20cm. In depth consolidating deposited layer by ramming and watering.

1.0. Workmanship

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

1.2. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats: mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used.

1.3. The plinth shall be similarly filled with earth in layers not exceeding 20 cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4. The finished level of filling shall be kept to shape intended to be given to floor.

1.5. In case off large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required, shall also be as specified.

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

2.0. Mode of Measurements & Payment

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

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

Item No. :- 7

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 shall L-U excavated and shall be screened on site of work. Stacking of 75% of metal obtained from screening shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent, otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas { 2m x 1.5 m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in -any stack in a particular hectometer is found to be less then the standard measurements viz. 1.5 cmt. the entire collection in the hectometre shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a 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 elsc 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 oi 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 rcgular and proper size till the whole materials shall not be measured and finally accepted by the department. The spreading ot 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, deposing. conveyance with all lead and lift, filling the boxes including ail labour, tools, equipments and all other incidental expenses.

Item No. :- 8

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.

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

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

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

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

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

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

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

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

1.0 Mode of Measurement & Payment :

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

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

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

Item No. :- 9

Providing and laying Granular Sub Base Layer by providing coarse graded material grading - I using B.T. M.C. metal crushed stone aggregates 53.00mm To 9.50mm @ 50%, 9.50mm To 2.36mm @20 % And Stone Dust @30% as per table 400-1 of MORTH Fifth Revision gradation including levelling the material at site of work, mixing & spreading into grade and camber, watering & consolidation at O.M.C. with vibratory roller including cost of material, labour, etc. complete.

501 GRANULAR SUB-BASE**401.1 Scope**

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2. Materials

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

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

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

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

IS sieve Designation	Percent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR value (Minimum)	30	25	20

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

IS sieve Designation	Percent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	

26.5 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR value (minimum)	30	25	20

401.3 Strength of Sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

401.4. Construction Operations

401.4.1. Preparation of subgrade: Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 s applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 – 100 kN smooth wheeled roller.

401.4.2. Spreading and Compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mixture in-place method.

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

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above or 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum of pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7MN/m or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the loer edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super- elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high

spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

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

401.5. Surface Finish and Quality Control of Work

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

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

401.6. Arrangement for Traffic

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

401.7. Measurement for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

401.8. Rate

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

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

Item No. :- 10

Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.

501 WATER MIX MACADAM SUB-BASE/BASE

402.1 Scope

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

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. when vibrating or other approved types of compacting equipment are used, the compacted depth of single layer of the sub-base course may be increased to 200 mm upon approval of the Engineer.

402.2. Materials

402.2.1 Aggregates

406.2.1.1. Physical requirements: Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregate shall conform to the physical requirements set forth in Table 400-10 below.

TABLE 400-10. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE/BASE COURSES

	Test			Test Method	Requirements
1	*Los	Angels	Abrasion	IS:2386(Part-4)	40 percent (Max.)
	value			IS:2386(Part-4)	
	Or			or IS:5640**	30 percent (Max.)
	*Aggregate Impact Value				
2	Combined	Flakiness		IS: 2386 (Part-	30 per cent (Max.)
	Elongation		1)		**
	indices (Total)				

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

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles 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.

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

406.2.1.2 Grading requirements - The aggregates shall conform to the grading given in Table 400-11.

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

IS sieve designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-60
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

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

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

402.3. Construction Operations

406.3.1. Preparation of base: Clause 404.3.1. shall apply.

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

406.3.3. Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part -8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4. Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portion where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

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

- (i) Loading hoppers and suitable distribution mechanism
- (ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.

- (iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface bitumens.

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

406.3.5. Compaction: After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5km/h.

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

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

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

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

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

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

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

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

406.4. Opening to Traffic

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

406.5. Surface Finish and Quality Control of Work

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

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

406.6. Rectification of Surface Irregularity

where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5m long and 2 m wide. In no case shall depression be filled up with unmixed and upgraded material or fines.

406.7. Arrangement for Traffic

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

406.8. Measurement for Payment

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

406.9. Rates

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8.

Item No. :- 11

Earthwork for embankment including breaking clods, dressing with all lead and lift (excluding watering and consolidation) (E) From Borrow area within 7.0 Km. lead

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30cm 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 meters lead, and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighbourhood. In all cases, the materials shall be disposed off in a neat manner.
2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing, Bench marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.
3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The materials 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 section 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 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 of 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 250mm 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 15cm. When being placed in the embankment and a maximum of size 5cm when being placed in the top 45cm 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 5cm 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 0.1m 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 50mm so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment wing walls of culverts bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures upto distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item.

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

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections, longitudinal section etc. in token on 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 leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. deduction of 15% for shrinkage shall be made from gross measured quantity if measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any that might have taken place at the time of taking final measurements of the item.

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

(i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter.

(ii) The width of the drain shall be restricted to 1.5mts, only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.

Item No. :- 12

Rolling & Watering of earthwork in layers with Vibratory roller 80 to 100 KN static weight including filling in depressions which occur during the process as directed.

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

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

If the materials delivered to the road bed is too wet is shall be dried, by evaporation and exposure to the sun, till the moisture content is brought done 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 the time of the compaction it is in the range of 1 percent 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 hand lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5 meter portion of the embankment below the 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 of other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

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

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

Table 1.2 Compaction requirements for embankment.

Sr. No.	Type of Work Materials	Field dry density as per centage 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 insite of that the specificated 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 as per actual quantity spreaded from the stacks recoded. The Payment shall be on Cubic meter basis.
- 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. :- 13

Providing and Applying Prime Coat with Bitumen Emulsion on preapred surface of granular base coarse including clearing the surface and spraying priming coat at the rate of 0.75 Kg/Sqm Using mechanical means mechanically mix (pug mill) carriage of mix material by contractors own tipper to site of work incl. laying, spreading and compecting in sub base, base course on well prepared under base of compecting as per MOST specification to achive the desired density

502. PRIME COAT OVER GRANULAR BASE

502.1. Scope

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

502.2. Materials

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

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

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

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

Type of surface	Kinematics Viscosity of Primer at 60°C (Centistokes)	Quantity of Liquid Bituminous Material Per 10 Sq.m./Kg
Low porosity	30-60	6 To 9
Medium porosity	70-140	9 To 12
High porosity	250-500	12 To 15

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

502.3. Weather and Seasonal Limitations

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

502.4. Construction

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

502.4.2. Preparation of road surface: The surface to be primed shall be prepared in accordance with Clauses 501.8 and 902 as appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the surface layer is slightly

moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

502.4.3. Application of bituminous primer : The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. Where a geosynthetic is proposed for use, the requirements of Clauses 703.3.2 and 703.4 shall apply. The bituminous primer shall be sprayed uniformly in accordance with Clause 501. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

502.4.4. Curing of primer and opening to traffic: A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

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

502.5. Quality Control of Work

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

502.6. Arrangements for Traffic

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

502.7. Measurement for Payment

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

502.8. Rate

The contract unit rate for prime coat with adjustments as described in Clause 502.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of **7.50 kg per 10 square meter**, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials referred to in Clause 502.4.3.

Item No. :- 14

Providing, laying And rolling 50.00 mm thick compacted Bitumeneous Macadam (B.M.) in one layer with B.T. aggregates as specified and using RS-1 Emulsion for tack coat at the rate of 2.50 Kg/ 10Sqm. on B. T. Surface (As per IRC- 16) and using bitumen for mixing with aggregate at the rate of 3.40 % i.e. 34.00 kg/ MT of total mix, including heating and mixing in Batch mix plant and spreading the same by Paver finisher and consolidation with Vibratory roller including necessary including cost of Hire charges, firewood, fl, Lubricants, labour charges,etc. by using contractor's own Drum mix plant, machineries and equipment, tools etc. complete in accordance with the requirement of specification.

Scope :

The work shall consist of construction in one course having 45/50mm. thickness in 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 specification and in conformity with the lines, grades and cross section shown on the drawing or as directed by the Engineer. Bituminous macadam is more open graded than the dense graded bituminous materials described in Clause 507,508 & of MORT & H.

Materials :**Bitumen :**

The bitumen shall be paving bitumen of Penetration Grade VG-30 complying with Indian Standard Specifications for "Paving Bitumen" Is : 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environment conditions. Guidelines on selection of bitumen shall be as per Appendix 4 of MORT & H.

Cationic rapid setting emulsion:

The cationic rapid setting emulsion is complying with the requirement of I.S. 8887.

Guidelines on selection of bitumen shall be as per Appendix 4 of MORT & H.

Coarse Aggregates:

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

The aggregate shall satisfy the physical requirement set forth in table 500-3.

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

Fine aggregates:

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

TABLE 500-3
PHYSICAL REQUIREMENT FOR COARSE AGGREGATES FOR
BITUMINOUS MACADA

Sr. No.	Test	Test Method	Requirement
1.	Strength*: Los Angles Abrasion Value	IS:2386(Part-4)	40% Maximum
2.	Strength*: Aggregate impact Value	IS:2386(Part-4)	30% Maximum
3.	Particle shape : Flakiness & Elongation Index (Combined)	IS 2386 (Part-1)	30% Maximum
4.	Cleanliness : Grain size analysis 0.075 mm. sieve	IS:2386(Part-1)	Maximum 5%Passing
5.	Coating and stripping of bitumen aggregate mixtures	IS:6241	Minimum retained coating 95%
6.	Soundness		
	i) Loss with sodium sulphate	IS-2386 (Part-5)	12% Maximum 5 cycles
	ii) Loss with Magnesimsulphate 5 cycles.		18% Maximum
7.	Water Absorption	IS:2386 (Part-3)	02% Maximum
8.	Water Sensitivity**:Retained Tensile	Minimum 80% Strength	

* Aggregate may satisfy requirements of either of the two tests

** The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95%

The elongation test to be done only on non-flays aggregates in the sample.

Aggregates grading and binder content :

When tested in accordance with IS:2386 Part I (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 500-4 for the grading specified in the contract. The type and quantity of bitumen, and appropriate thickness, are also indicator for each mixture type.

Proportioning of materials :

The aggregate shall be proportioned to produce a uniform mixture complying with the requirements of Table 500-4 of MORT & H. The binder content shall be within a tolerance of ± 0.3 percent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900 of MORT & H. The bitumen content for premixing shall be 3.4 percent by weight of the total mix except when otherwise directed by the Executive Engineer.

TABLE NO. 500-4
AGGREGATE GRADING FOR BITUMINOUS MACADAM

Mix designation	Grading 1	Grading 2
Nominal aggregate size	40 mm.	19 mm.
Layer thickness	80 – 100 mm.	50 – 75 mm.
IS Sieve (mm.)	Cumulative % by weight of total Aggregate passing.	
45.0	--	--
37.5	--	--
26.5	--	100
19.0	--	90-100
13.2	--	56-88

4.75	--	16-36
2.36	--	4-19
0.30	--	2-10
0.075	--	0-8
Bitumen content, % by weight of total mixture	--	3.4%
Bitumen grade	--	VG - 30

Notes : 1. Appropriate bitumen contents for condition in collar area of India may be up to 0.5% higher subject to the approval of the Engineer.

Construction Operation :

Weather and seasonal limitations :

The laying shall be suspended while freestanding water is present on the surface to be covered, or during rain, fog and dust storms. After rain, the bituminous surface, primer or tack coat, shall be blown off with a high pressure air jet to remove excess moisture, or the surface left to dry before laying shall start. Laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10⁰ C or when the wind speed at any temperature exceeds 40 Km / h at 2 m. height specifically approved by the Engineer-in-charge

Preparation of the base :

The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the required profile in accordance with Clause 501.8 & 902.3 of MORT & H as appropriate, and prime, coat shall be applied in accordance with Clause 502 of MORT & H where specified, or as directed by Engineer.

Tack coat :

The work shall consist of the application of a single coat of rapid setting emulsion bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mi, when specified in the Contract or instructed by the Engineer.

Binder : The binder used for mixing shall be 80-100 Grade bitumen complying with IS 73 or a type and grade as specified in the Contractor or as directed by the Engineer.

Weather and seasonal Limitations :

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

Equipment :

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

Preparation of base :

The surface on which the tack coat is to be applied shall be cleaned and free from dust, dirt, and any extraneous material, and to be otherwise prepare in accordance with the requirements of Clauses 501.8 and 902 of MORT & H as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high-pressure air jet, or by other means as directed by the Engineer.

Application of tack coat :

The application of tack coat shall be at the rate of 2.50 Kg per 10 Sqm. As 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. 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 materials to receive an overlay is 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 complete within two days. Work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface.

Type of Surface		Quantity of liquid bituminous Material in Kg. per Sq.m. area
i)	Normal bituminous surfaces	0.20 to 0.25
ii)	Dry and hungry bituminous surfaces	0.25 to 0.30
iii)	Granular surface treated with primer	0.25 to 0.30
iv)	Non bituminous surface	
	(a) Granular base (not primed)	0.35 to 0.40
	(b) Cement concrete pavement	0.30 to 0.35

Curing of tack coat :

The tack coat shall be applied just a head of the oncoming bituminous construction. The tack coat shall be left to cure until all the volatiles evaporated before any subsequent construction is stated. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

Quality control of Tack Coat work :

For control of the quality of materials supplied and the works carried out, the relevant provision of section 900 of MORT & H shall apply.

Preparation and transport of mix :

Mixing :

Pre-mixed bituminous materials, including bituminous macadam, dense bituminous macadam, semi-dense bituminous concrete and bituminous concrete shall be prepared in Continuous Batch mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperature can be found in Table 500-5 of these specification, the difference in temperature between the binder and aggregate should at no time exceed 14°C . In order to ensure uniform quality of the mix and between coating of aggregates, the Continuous Batch mix plant shall be calibrated from time to time.

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

Transporting :

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

Spreading

Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, leveled and tamped by an approved self-propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver, and its method of operations, shall be adjusted to ensure an even and uniform flow of bituminous materials across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where mechanical paver cannot be used, the materials shall be spread, raked and leveled with suitable hand tools by experienced staff, and compacted to the satisfaction of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching and expansion joint of structure, machine laying shall stop 300 mm. short of the joint.

The remainder of the pavement up to the joint, and the corresponding area beyond it, shall be laid by hand, the joint or joint cavity shall be kept clear of surface material.

Bituminous material, with a temperature greater than 145° C, shall not be laid or deposited on bridge deck waterproofing system, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre-mixed bituminous material shall only be permitted in the following circumstance :

- (i) For laying regulating course of irregular shape and varying thickness.
- (ii) In confined space where it is impracticable for a paver to operate.
- (iii) For footways.
- (iv) At the approaches to expansion joints at bridges, viaducts, or other structures.
- (v) For laying mastic asphalt in accordance with Clause 515 of MORT & H.
- (vi) For filling of potholes.
- (vii) Where directed by the Engineer.

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

- (i) At the edges of the layers of material and at gullies and manholes.
- (ii) At the approaches to expansion joints at bridges, viaducts or other structures. As directed by the Engineer.

Bitumen Penetration (°C)	Bitumen Mixing	Aggregate Mixing (°C)	Mixed Mixing (°C)	Rolling Mixing (°C)	Laying Mixing (°C)
35	160 – 170	160 – 175 Maximum	170 Minimum	100 Minimum	130
65	150 – 165	150 – 175 Maximum	165 90 Minimum	125 Minimum	
90	140 – 160	140 – 165 Maximum	155 Minimum	80 Minimum	115

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 6 km. / h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling of the longitudinal joint 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-direction cambered portion, 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 wheelers 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 wheel. The second or intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 kN static weight or pneumatic typed 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 500-100) there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose, nor excessive water poured on the wheels.

Rolling operations shall be complete every respect before the temperature of the mix falls below 100 degree C.

Roller (s) shall not stand on newly bid 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 appropriate binder before the new mix is placed against it.

Joints :

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

- (i) By heating the joints with an approved joint heater when the adjacent width is beating laid, but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material, to within the specified range of minimum rolling temperature and maximum temperature at any stage for the material, for a width not less than 75 mm. The Contractor shall have equipment available, for use in the event of a heater breakdown, to form joints by method (iii),
- (ii) by using two or more pavers operating in echelon, where this is practicable and in sufficient proximity for adjacent width to be fully compacted by continuous rolling.
- (iii) by cutting back the exposed joints, for a distance equal to the specified layer thickness, to a vertical face, discarding all loosened material and coating the vertical face completely with 80 / 100 penetration grade hot bitumen, or cold applied bitumen, or polymer modified adhesive bitumen tape with a minimum thickness of 2 mm. before the adjacent width is laid.

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

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is not further movement under the roller. The required frequency of testing is defined in Clause 903 of MORT & H.

Surface Finish and Quality Control of Work :

The surface finish of the complete construction shall conform to the requirements of Clause 902 of MORT & H. For control of the quality of material supplied and works carried out, the relevant provision of Section 900 to MORT & H shall apply.

Protection of layer :

The bituminous macadam shall be cover 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, the course shall be cover by a seal coat to the requirement of Clause 513 of MORT & H. 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.

Arrange of Traffic :

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

Measurements for Payment :

Bituminous macadam shall be measured by weight in metric tones, where used as regulating course, shown on the drawings, or as otherwise by the Engineer.

Rate :

The contract unit rate for the bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to :

- (a) Making arrangements for traffic to Clause 112 of MORT & H except for initial treatment to verge, shoulders and construction of diversions.
- (b) Preparation of the surface to receive the material.
- (c) Providing all materials to be incorporated in the work including arrangement for stock yard, all royalties, fees, rents where necessary and all leads and lifts.
- (d) Mixing transporting, laying and compacting the mix as specified.
- (e) All labour, tools, equipment, plant including installation of Continuous Batch mix plant, power supply units and all machineries, incidental to complete the work to these Specifications.
- (f) Carrying out the work in part width of the road where directed.
- (g) Carrying out all tests for control of quality, and
- (h) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (i) The rates for premixed material are to include for all wastage in cutting of joints etc.
- (j) The rates are to include for all necessary testing, mix design transporting and testing of samples, and cores. If there is not a project specific laboratory, the Contractor must arrange to carry out all necessary testing at an outside laboratory, approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
- (k) The cost of all plant and laying trials as specified to proved the mixing and laying methods deemed to be included in the Contractor's rates for the materials.
- (L) The payment shall be made on 1 M.T. basis.

Item No. :- 15

Providing & Laying 25 mm thick S.D.B.C. using stone chips as per Gradation of M.O.R.T. & H. specification using bitumen at rate of 50 Kg./M.T. including heating the asphalt (VG-30 grade) and aggregate and laid by paver finisher including consolidation with vibratory roller including machinaries, equipments, tools, plants, oil, firewood, keroscene and all labour charges etc. complete.

Scope

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

Materials

Bitumen : The Bitumen shall be VG-30 paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS : 73 and of the penetration indicated in Table 500-15, for semi dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 521, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in the Manual for construction and Supervision of Bituminous Works.

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

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

Filler : Filler shall be generally as specified in Clause 507.2.4

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

Aggregate grading and binder content : When tested in accordance with IS : 2386 Part-1 (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-1-5 for gradings' 1 to 2 as specified in the Contract.

Mixture Design**Requirements for the mixtures :**

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

TABLE 500-14. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR SEMI DANSE BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (Dust)	Grain size analysis	Max. 5% passing 0.075 mm. sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasions value. Aggregate Impact value.	Max. 35% Max. 27%
Polishing	Polished Stone Value	Min. 55%
Durability	Soundness	
	Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures	Minimum Retained coating 95%
Water Sensitivity	Retained Tensile Strength	Min. 80%

- | | |
|---|---------------------|
| 2) IS : 2386 Part I | 7) IS : 2386 Part-3 |
| (The elongation test may be done only non flaky aggregates in the sample) | |
| 3) IS : 2386 Part 4* | 8) AASHTO T 283** |
| 4) IS : 2386 Part 4* | 9) IS : 6241 |
| 5) BS : 812 Part 114 | |

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

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

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

Binder Content :

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

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

Grading	2
Nominal aggregate size	10 mm.
Layer thickness	25 – 30 mm.
IS Sieve (mm.)	Cumulative % by weight of total aggregate passing.
13.2	100
9.5	90 - 100
4.75	35 - 51
2.36	24 – 39
1.18	15 – 30
0.3	9 – 19
0.075	3 – 8
Bitumen content % by of total mix	Min. 5.0
Bitumen grade (pen)	VG-30

Note :

1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
2. Determined by the Marshall method.

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

Minimum stability (kN at 60 ⁰ C)	8.2
Minimum flow (mm.)	2
Maximum flow (mm.)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3 – 5
Per cent voids in mineral aggregate (VMA)	See Table 500 – 12
Per cent voids filled with bituemen (VFB)	65 – 78

Job mix formula :

The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-1 6 as obtained by the Contractor.

Plant trials – Permissible variation in job mix formula :

The requirements for plant trials shall be as specified in Clause 507.304, and permissible limits for variation as shown in Table 500-13.

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

Construction Operations :

Weather and Seasonal limitations : The provision of Clause 501.5.1 shall apply.

Preparation of base :

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

Geosynthetics :

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

Stress absorbing layer :

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

Mixing and transportation of the mixture :

The provision as specified in Clauses 501.3 and 501.4 shall apply.

Spreading : The general provisions of Clauses 501.5.3 and 501.5.4 shall apply

Rolling : 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 6 km. / h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling of the longitudinal joint 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-direction cambered portion, 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 wheelers 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 wheel. The second or intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 KN static weight or pneumatic typed 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 500-100) there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the

wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose, nor excessive water poured on the wheels.

Rolling operations shall be complete every respect before the temperature of the mix falls below 100 degree C.

Roller (s) shall not stand on newly bid 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 appropriate binder before the new mix is placed against it.

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

Surface Finish and Quality Control.

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

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

Measurement for payment : The measurements shall be all as specified in Clause 507.8.

Rate : The Contract unit rate shall be all as specified Clause 507.9, except that the rate shall include the provision of bitumen at 5.00 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly.

The payment shall be made on 1 M.T. basis

Item No. :- 16

Excavation for foundation in sand, gravel, clay soft soils and murrum etc. including shoring, strutting dewatering as necessary and disposing of the excavated stuff as directed. (A) Depth upto 3.0 M. and lead upto 100m for 10 Cum

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, shoring, bracing draining and pumping and the removal of all logs, stumps, grubs and other deleterious matter and obstructions necessary for placing 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 and slopes.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of persons and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be as shown, on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
5. Where waters are met with in excavation due to stream-flow, seepage springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, constructing diversion channels drainage channels, and other necessary work to keep the foundation trenches dry when so required and to protect green concrete/masonry against damage by erosion or sudden rising of water level. The method to be accepted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the work.
6. 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 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 tooling 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. Back filling shall be done with approved material after concrete or masonry is fully set and carried out in such a 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 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 ail logs stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads upto 100 metres;
6. All labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.

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

Item No. :- 17

Providing and filling in foundation with ordinary Cement Concrete M-100 mix and providing necessary vertical pin headers including formwork vibrating ramming and curing complete.

Item No. :- 18

Providing and casting in situ ordinary cement concrete M-150 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete without V-Grooves.

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

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre : 1000 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

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

Note:- A mix leaner than M-100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall 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 steining and R.C.C. Piles	40 mm
ii.	R.C.C. well steining	63 mm
ii	Well cap or pile cap, solid type piers, abutments and wing walls and their pier caps	40 mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls and their pier caps	20mm
iv	R.C.C. bearings	20 mm
v	For any other item of construction not covered by items (i) to (v) Engineer	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 shall be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work.
8. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.
9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer 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 shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform ? Dry coarse and

fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. Enough water shall then be added gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixer shall contain only two third of normal quantity of coarse aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened swept clean, thoroughly wetted, and cleaned with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushed, care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.
16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting Under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event, of break downs.
17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories :-

- (1) Shuttering i.e. from work required for forming the concrete
- (2) Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions show on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

- 19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks of hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specialty in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as too removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of framework to avoid sharp comers.
- 20. The inside surface of forms shall except in the case of permanent from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.
- 21. Special measures shall be taken to ensure that the framework does no hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangement must be made to ensure that the from does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork 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 false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery materials and for results obtained.
- 22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of the load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not

controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such extent and character as to affect materially or to endanger the life of the structure or 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 upon the nature of work and methods of vibration of concrete shall be determined by regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

25. Works strength tests shall be made in accordance with IS : 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 meter 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 changed irrespective of the quantity of concrete poured, The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals 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 percent of the cubes cast each day may have values less than the specified strength provided the lowest value is not less than 85 percent 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 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, kapachi 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 Asstt. Engineer / Addl. Asstt. Engineer / Overseer or as instructed by the Engineer-in-charge. After removal of form work and suturing, the executive Engineer shall inspect the work and satisfy by random checks 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 unit rate for concrete shall include the cost of all materials, labour, tools and plant 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 shown 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.
31. The payment will be made on cumt. basis of the finished work.

Item No. :- 19

Providing and laying in position FE 500/500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following. (A) Piers (B) Abutments (C) R.C.C. Returns

2.0 MATERIAL

2.1 TMT Bars / CRS Steel

Reinforcements may be either E.M.T. tensile steel, high strength deformed bars. They may be uncoated or coated with epoxy or with approved protective coatings.

2.6 T.M.T. bars reinforcement for RCC work shall conform IS 432 (Part II) 1966 and shall be of tested quality. It shall also comply with relevant part of IS 456-1966.

2.7 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.

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

2.9 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

6.0 Pitch

6.1 Distance between bars shall be as specified in drawings and as directed by the Engineer-in-charge all bars shall be laced 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.

7.0 Binding Wire

7.1 Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-1972

7.2 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.

7.3 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.

8.0 PROTECTION OF REINFORCEMENT

8.1 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.

8.2 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.

6.3 workmanship

6.4 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.

6.5 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.

10.0 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.
- 8.10** 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.
- 8.11** Bars shall be kept in position usually by the following methods :
In case of beam an slab be placed between the bars and formwork subject to Satisfactory evidence that th 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.
- 8.12** 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.
- 8.13** 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 bee, allowed to sag between supports.
- 8.14** 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.
- 8.15** Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.
- 8.16** 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 hled in place by use of plastic or plastic coated binding wires especially manufactured for the purpose.
- 8.17** Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.
- 11.0 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 111/4 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 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.

10.10 The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer.

10.11 Bars shall be bent 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 bent 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.

10.12 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 spilling of the concrete.

10.13 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 bars 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 lapped and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

10.14 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 sheer not bending moments is maximum.

- 10.15** 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 standards threads Steel threads Steel for coupling shall conform to IS : 225.

- 10.16** When permitted or specified on the drawings joints of reinforcement bars shall bult-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 maximmm permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded only electric are welding using a process which excludes air form 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.

12.0 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	40 mm	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 tones on the basis of IS:1732. Wastage, Overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for bidning and placing shall not be measured and cost of these itmes 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.

- 11.4** The rate shall be for a unit of **One MT.**

Item No. :- 20

Providing & Casting in-situ controlled cement concrete M-250 mix with trimix C.C. Road laid as directed including tamping, vibrating, finishing, curing and filling joint with bitumen etc as Directed and approved by engineer in charge.

1.0. 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. Graded stone aggregate 20 mm nominal size shall conform to M-12.

2.0. General

2.1. The concrete mix is not required to be designed by preliminary testes. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by volume concrete work shall have exposed concrete surface or as specified in the item

2.2. The designation ordinary M-100, M-150m M-200, M-250 specified as per I.S. correspond approximately to 1:3:6, 1:2:4, 1:1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively

2.3. The ingredients required for ordinary concrete containing one beg of cement of 50 kg. by weight (0.0342 Cu M.) for different proportions of mix shall be as under:

Grade of concrete	Total quantity of dry aggregate by volume per 50 kgs. of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kgs. of cement maximum
M-100 (1:3:6)	300 Liters	Generally 1:2 for line aggregate to coarse aggregate by volume 160 but subject to an upper limit of 1:1.1/2 and lower limit	34 Liters
M-150 (1:2:4)	220 Liters		32 Liters
200 (1:1.1/2:3)			30 Liters
M-250 (1:1:2)	100 Liters		1:3 27 Liters

2.4. The water cement ratios shall not be more than specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be met eased to overcome the difficulties of placements and compaction so that the water-cement ratio specified in the table is not exceeded.

2.5. Workability of the concrete shall be controlled by maintaining a water -cement-ratio that is found to give a concrete mix which is just sufficient wet to be placed and compacted without difficulty with the means available.

2.6. The maximum size of course aggregate shall be as large as possible within the limits specified but in no case greater than one forth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

2.7. For reinforced concrete work; coarse aggregates having a nominal size of 20 mm. are generally considered satisfactory.

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

2.9. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important, and the nominal maximum size may some times be as great as or greater than the minimum cover.

2.10. Admixture maybe used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time neither the compressive strength of concrete is reduced not are other requisite qualities of concrete and steel impaired by the use of such admixtures.

3.0. Workmanship

Proportioning : Proportioning shall be done by volume, except which shall be measured in terms of bags of 50 kg. weight, the volume of one such bag being taken as 0.0342 cu. meter

Boxes of suitable size shall be used for measuring sand aggregate. The size of boxes (internal) shall be 35 x 25 cms. and 40 cms deep while measuring the aggregate and sand the boxes shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made.

3.2. Mixing :

3.2.1. For all work, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the claim of the mechanical mixer while it is continuously running. After half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

3.2.2. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Specified quantity water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

3.2.3. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer in-charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

3.3. Consistency:

3.3.1. The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump tests in accordance with I.S. 1199-193. The slump of 10 mm. to 25 mm shall be adopted when vibrators are used and 80 mm. when vibrators are not used.

3.4. Inspection:

3.4.1. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men machinery materials and for results obtained immediately before concreting all forms shall be thoroughly cleaned.

3.4.2. Centering design and its erection shall be got approved from the engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile 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 spacers or metal pieces shall not be used for this purpose.

3.5. Transporting and laying:

3.5.1. The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water dust, snow or

ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the engineer-in-charge has been obtained.

3.5.2. Concreting shall proceed continuously over the area between construction joints. Fresh concrete proper contraction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

3.5.3. Unless otherwise agreed to by the Engineer-in-charge concrete shall be dropped in to place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all lateness shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first 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.

3.5.4. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns. Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

3.6. Curing:

Immediately after compaction, concrete weather including rain, running water, shocks, vibration, traffic, rapid temperature charges, frost and drying out process. It shall be covered with wet sacking has Sian or other similar absorbent material approved, soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

3.7. Sampling and testing of concrete:

3.7.1. Samples from fresh concrete shall be taken as per I.S. 1199-1959 and cubes shall be made, cured and tested at 7 days and 28 days as per requirements in accordance with I.S. 526-1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work.	No of samples	Quantity of concrete in the works	No of samples
No of samples	1	16-30 cmt	3
6.15 cmt.	2	31-50 cmt.	4
51 and above	4±	one additional for each additional 50 mm. or part thereof.	

Note : At least one sample shall be taken from each shift, Ten test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting as per above frequency. The number of

specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

3.7.2. The average of the group of cubes cast for each day shall not be less than the specified cube strength of 150 K/g Cm² at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the Proportions given for a particular grade shall not, however be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

3.8. Stripping:

3.8.1. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time of removal of form work, 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. In normal circumstances (generally where temperatures are above 20°C) and where ordinary concrete is used, forms may be struck after expiry of periods specified in item No.9.1 (A) for respective item of form work.

3.8.2. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soles and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal tiles are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shutting, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

3.8.3. Immediately after the removal of forms, all exposed bolts etc. 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 tiles 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 proportions used in the grade of concrete that is being furnished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which are pointed shall be kept moist for a period of 24 hours. If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of structure affected.

4.0. Mode of Measurement & Payment

4.1. The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for (a) Ends of dissimilar materials such as joints, beams, posts, girders, gables, purling trusses, corbels and steps etc., up to 500 Sq. Cm. in section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate excludes the cost of form work.

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

Item No. :- 21

Filling around the pipes with murrum including dressing, tampering etc. complete.

Area around pipes shall be filled with murrum, chhara or other gritty material immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter, and lumps and shall be approved by the Engineer-in-charge. Filling upto 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, tampered or vibrated in layers of not exceeding 150 mm: particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur. In case of high embankments, after filling upto the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted. Materials shall be filled in pharas 3m. x 1.5m x 0.5m size and shall be measured in cubic metres. Unit rate includes cost of materials and spreading including labour and tools needed for the above operations.

Item No. :- 22

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M.1:2 watering and laying (to level or slope) of I.S. class NP3 of following internal diameters.(Vii) 1200mm dia.

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP4 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the palce of manufacture or at the site before their incorporation in the works.

NP4, NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's latter head the given hereinafter form.

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

FORM OF CERTIFICATE FOR NP4, NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce B.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites. We have experience of manufacturing of pipes of _____ years The pipes supplied by us to

M/s. _____ satisfy the requirement of IS : 458

Date: _____

Place :. _____

Manufacturer's Sign _____

3. No pipe shall be palced in position until the foundations have been approved by the Engineer-incharge. Where two pr more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at feat half the diametre of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking, space shall be between 13 and 20 mm according to the diametre of the pipes., Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and

consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. R. C. C. pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No. :- 23

Providing Temporary diversion suitable for traffic during the construction period of the CD work by levelling existing ground and supplying and spreading Hard Murrum in layer etc complete as per specification

112.1. General

The Contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the highway. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

112.2. Passage of Traffic along a part of the Existing Carriageway under Improvement

For widening/strengthening existing carriageway when 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 atleast 150 mm thick granular base course covered with bituminous surface dressing in a width of atleast 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 atleast 20m long with additional paved width of 2.5m 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 disposal of and the area cleared as per the direction of the Engineer.

112.3. Passage of Traffic along a Temporary Diversion

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 m carriageway and 2.5m earthen shoulders on each side (total width of roadway 12 m) with the following provision for road crust in the 7m width:

- (i) 200 mm (compacted) granular subbase;
- (ii) 225 mm (compacted) granular base course; and
- (iii) Premix carpet with Seal Coat / Mix Seal Surfacing.

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

112.4. Traffic safety and Control

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

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

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

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

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

112.5. Maintenance of Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in a satisfactory condition till such time they are required as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent applications of water, if necessary.

112.6. Measurements for Payment and Rate

All arrangements for traffic during construction including provision of temporary cross drainage structures, if required, and treated shoulder as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be the Contractor's responsibility.

The construction of temporary diversion including temporary cross drainage structures as described in Clause 112.3, shall be measured in linear metre and the unit contract rate shall be inclusive of full compensation for construction (including supply of material, labour, tools etc.), maintenance final dismantling, and disposal.

Item No. :- 24

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (to level or slope) of I.S. class NP3 of following internal diameters. (V) 900mm dia.

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce B.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites. We have experience of manufacturing of pipes of _____ years The pipes supplied by us to

M/s. _____ satisfy the requirement of IS : 458

Date: _____

Place : _____ Manufacturer's Sign _____

3. No pipe shall be palced in position until the foundations have been approved by the Engineer-incharge. Where two pr more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at feat half the diametre of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking, space shall be between 13 and 20 mm according to the diametre of the pipes., Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. R. C. C. pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No. :- 25

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (to level or slope) of I.S. class NP3 of following internal diameters. (IV) 750mm dia.

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

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

M/s. _____ satisfy the requirement of IS : 458

Date: _____

Place : _____ Manufacturer's Sign _____

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at 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 the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. R. C. C. pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No. :- 26

Providing parapet of ordinary cement concrete M-200 as per detailed drawings with necessary reinforcement including, shuttering, laying vibrating and finishing to line and level complete. (ii) Cast in situ.

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

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre : 1000 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

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

Note:- A mix leaner than M-100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall 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 steining and	40 mm

	R.C.C. Piles	63 mm
ii.	R.C.C. well steining	40 mm
ii	Well cap or pile cap, solid type piers, abutments and wing walls and their pier caps	20mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls and their pier caps	20 mm
iv	R.C.C. bearings	As specified on the
v	For any other item of construction not covered by items (i) to (v)	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 shall be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work
8. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.
9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer 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 shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform ? Dry coarse and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. Enough water shall then be added gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.
12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the

first batch of concrete from the mixer shall contain only two third of normal quantity of course aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened swept clean, thoroughly wetted, and cleaned with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushed, care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.
16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting Under water, where vibrators cannot be used Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event, of break downs.
17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories :-
 - (1) Shuttering i.e. form work required for forming the concrete
 - (2) Scaffolding i.e. formwork required for supporting shuttering.Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions

show on the drawings. All bolts and reverts shall be counter-suck and well ground to provide a smooth, plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks of hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specialty in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as too removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of framework to avoid sharp comers.
20. The inside surface of forms shall except in the case of permanent from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons a and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the framework does no hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangement must be made to ensure that the from does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork 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 false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery materials and for results obtained.
22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of the load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength test 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 from work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any stock or vibrations. Supports shall be removed in such a manner as to permit the

contract the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework R shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by from joints, all cavities produced by the removal of from ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such extent of and character as to affect materially or to endanger the life of the strength or 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 upon the nature of work and. methods of vibration of concrete shall be determined regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

25. Works strength tests shall be made in accordance with IS : 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 meter of concrete or a part thereof. However if concreting done in a day is 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 when ever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitable increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals 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 percent of the cubes cast each day may have values less than the specified strength provided the lowest value is not less than 85 percent 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 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 as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the

reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer / Addl. Asstt. Engineer / Overseer or as instructed by the Engineer-in-charge. After removal of 'form work and suturing, the executive Engineer shall inspect the work and satisfy by random checks 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 unit rate for concrete shall include the cost of all materials, labour, tools and plant 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 shown 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.
31. The payment will be made on Rmt. basis of the finished work.

Item No. :- 27

Providing and laying rubbles for Apron (Each stone weighing not less than 40kg) including and packing and filling in the interstices with quarry spall.

1. The rubble stones shall be black in colour, shall be hard, tough, sound durable and of close texture, free from cracks and it shall be obtained from the approved quarries.
2. The rubble obtained from the top surface of the quarry is soft one and hence such soft variety shall not be accepted. All unsound weathered or disintegrated stones obtained from the upper portion of the quarry shall be rejected.
3. The quarry shall be well protected shall be dug by removing all the katcha and weathered stuff till approved quality of materials is available.
4. The length and breadth shall not exceed $1/t$ (f.2) times the thickness of the stones.
5. The rubble stacks shall be made on a fairly level ground and stacks shall be so made that rubble stones are stacked as close as possible so as to leave no excessive voids and no hollows are left out.
6. The tendency to prepare the stacks by keeping excessive voids or keeping hollow places shall not be tolerated.
7. The stacks shall be uniform in length and breadth and top portion shall be in level so that height at any point is uniform.
- B. All the stacks shall be of standard dimensions which shall be prescribed by the Executive Engineer deduction for voids shall not be made.
9. The rubble shall be got approved by the Executive engineer, prior to collector on site or otherwise it is liable to rejection for which no claim shall be entertained.
10. The contractor shall maintain all stacks in regular and proper sizes till the whole material is collected Measured and finally accepted by the department. 15 percent spauls will be allowed for filling in interstices.
11. The rubble shall be stacked in quantities as per hectometre wise requirement as directed by the Executive Engineer or his agent.
12. Measurement shall be given only when the full quantity of a half kilometer is stacked measurements shall be recorded and paid only once in a hectometre and no piecemeal measurements shall be recorded and paid.
13. Stacks shall be made as per actual requirements and any material in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.

Item No. :- 28

Providing and filling in foundation with ordinary cement concrete M-150 mix and providing necessary vertical pin headers including form work, 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 aggregate and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M-100, M-150, M-200 and M-250.
2. In the designation of a concrete mix letter M refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg./cm.
3. The ordinary concrete mix shall generally be specified by volume for cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking ramming or hammering shall not be done proportioning of sand be as per its dry volume. In case it is dam, allowance for bulking shall be made as per IS : 2386 (Part-III).
4. In gradients required for ordinary / concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre : 1000 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

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

Note:- A mix leaner than M-100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall 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 steining and	40 mm

	R.C.C. Piles	63 mm
ii.	R.C.C. well steining	40 mm
ii	Well cap or pile cap, solid type piers, abutments and wing walls and their pier caps	20mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls and their pier caps	20 mm
iv	R.C.C. bearings	As specified on the
v	For any other item of construction not covered by items (i) to (v) by items (i) to (v) Engineer	or as desired by the 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 shall be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work
8. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used. their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.
9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer 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 shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform ? Dry coarse and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. Enough water shall then be added gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.
12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the

first batch of concrete from the mixer shall contain only two third of normal quantity of course aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened swept clean, thoroughly wetted, and cleaned with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushed, care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.
16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting Under water, where vibrators cannot be used Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event, of break downs.
17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories :-
 - (1) Shuttering i.e. form work required for forming the concrete
 - (2) Scaffolding i.e. formwork required for supporting shuttering.Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions

show on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks of hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specialty in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as too removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of framework to avoid sharp comers.
20. The inside surface of forms shall except in the case of permanent form work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in form work of concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the framework does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangement must be made to ensure that the form does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork 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 false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery materials and for results obtained.
22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any form work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the

contract the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework R shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by from joints, all cavities produced by the removal of from ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such extent of and character as to affect materially or to endanger the life of the strength or 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 upon the nature of work and. methods of vibration of concrete shall be determined regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

25. Works strength tests shall be made in accordance with IS : 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 meter of concrete or a part thereof. However if concreting done in a day is than 15 cubic meter, the minimum number of cubes tests shall be carried out when ever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitable increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals 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 percent of the cubes cast each day may have values less than the specified strength provided the lowest value is not less than 85 percent 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 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 as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the

reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer / Addl. Asstt. Engineer / Overseer or as instructed by the Engineer-in-charge. After removal of 'form work and suturing, the executive Engineer shall inspect the work and satisfy by random checks 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 unit rate for concrete shall include the cost of all materials, labour, tools and plant 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 shown 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.
31. The payment will be made on cumt. basis of the finished work.

Item No. :- 29

Providing and casting in situ controlled cement concrete M - 250 for R.C.C. raft and cut-off walls including necessary shuttering, laying, vibrating, ramming and curing complete.

Item No. :- 30

Providing and casting in situ controlled cement concrete M - 250 for R.C.C. return as per drawing including centering, shuttering, scaffolding where necessary laying, vibrating, curing and finishing complete (A) Height from 0.00 to 5.0 Mt (1) Piers (2) Abutments (3) R.C.C. Return.

Item No. :- 31

Providing and casting in situ controlled cement concrete M - 250 for R.C.C. solid slab including centering, scaffolding curing and finishing complete.

Item No. :- 32

Providing and casting in situ controlled cement concrete M - 250 for wearing coat laid as directed including tamping, vibrating, curing and finishing, curing and filling joints with bitumen complete.

1.0. 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. Graded stone aggregate 20 mm nominal size shall conform to M-12.

2.0. General

2.1. The concrete mix is not required to be designed by preliminary testes. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by volume concrete work shall have exposed concrete surface or as specified in the item

2.2. The designation ordinary M-100, M-150m M-200, M-250 specified as per I.S. correspond approximately to 1:3:6, 1:2:4, 1:1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively

2.3. The ingredients required for ordinary concrete containing one bag of cement of 50 kg. by weight (0.0342 Cu M.) for different proportions of mix shall be as under:

Grade of concrete	Total quantity of dry aggregate by volume per 50 kgs. of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kgs. of cement maximum
M-100 (1:3:6)	300 Liters	Generally 1:2 for fine aggregate to coarse aggregate by volume 160 but subject to an upper limit of 1:1.1/2 and lower limit	34 Liters
M-150 (1:2:4)	220 Liters		32 Liters
200 (1:1.1/2:3)			30 Liters
M-250 (1:1:2)	100 Liters		1:3 27 Liters

2.4. The water cement ratios shall not be more than specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be met eased to overcome the difficulties of placements and compaction so that the water-cement ratio specified in the table is not exceeded.

2.5. Workability of the concrete shall be controlled by maintaining a water -cement-ratio that is found to give a concrete mix which is just sufficient wet to be placed and compacted without difficulty with the means available.

2.6. The maximum size of course aggregate shall be as large as possible within the limits specified but in no case greater than one forth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

2.7. For reinforced concrete work; coarse aggregates having a nominal size of 20 mm. are generally considered satisfactory.

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

2.9. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important, and the nominal maximum size may some times be as great as or greater than the minimum cover.

2.10. Admixture maybe used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures.

3.0. Workmanship

Proportioning : Proportioning shall be done by volume, except which shall be measured in terms of bags of 50 kg. weight, the volume of one such bag being taken as 0.0342 cu. meter. Boxes of suitable size shall be used for measuring sand aggregate. The size of boxes (internal) shall be 35 x 25 cms. and 40 cms deep while measuring the aggregate and sand the boxes shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made.

3.2. Mixing :

3.2.1. For all work, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Measured quantity of aggregate, sand and cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

3.2.2. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Specified quantity of water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

3.2.3. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer in-charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

3.3. Consistency:

3.3.1. The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump tests in accordance with I.S. 1199-193. The slump of 10 mm. to 25 mm shall be adopted when vibrators are used and 80 mm. when vibrators are not used.

3.4. Inspection:

3.4.1. 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 the safety of men machinery materials and for results obtained immediately before concreting all forms shall be thoroughly cleaned.

3.4.2. Centering design and its erection shall be got approved from the engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile 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 kapachi or metal pieces shall not be used for this purpose.

3.5. Transporting and laying:

3.5.1. The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the engineer-in-charge has been obtained.

3.5.2. Concreting shall proceed continuously over the area between construction joints. Fresh concrete proper contraction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

3.5.3. Unless otherwise agreed to by the Engineer-in-charge concrete shall be dropped in to place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first 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.

3.5.4. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns. Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

3.6. Curing:

Immediately after compaction, concrete shall be protected from weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking or jute or other similar absorbent material approved, soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

3.7. Sampling and testing of concrete:

3.7.1. Samples from fresh concrete shall be taken as per I.S. 1199-1959 and cubes shall be made, cured and tested at 7 days and 28 days as per requirements in accordance with I.S. 526-1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work.	No of samples	Quantity of concrete in the works	No of samples
No of samples	1	16-30 cmt	3
6.15 cmt.	2	31-50 cmt.	4
51 and above	4±	one additional for each additional 50 mm. or part thereof.	

Note : At least one sample shall be taken from each shift, Ten test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

3.7.2. The average of the group of cubes cast for each day shall not be less than the specified cube strength of 150 K/g Cm² at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the Proportions given for a particular grade shall not, however be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

3.8. Stripping:

3.8.1. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time of removal of form work, 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. In normal circumstances (generally where temperatures are above 20°C) and where ordinary concrete is used, forms may be struck after expiry of periods specified in item No.9.1 (A) for respective item of form work.

3.8.2. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soles and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

3.8.3. Immediately after the removal of forms, all exposed bolts etc. passing through the concrete member and used for shuttering or any other purpose shall be cut inside the 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 tiles 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 proportions used in the grade of concrete that is being furnished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all

voids. Surface which are pointed shall be kept moist for a period of 24 hours. If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of structure affected.

4.0. Mode of Measurement & Payment

4.1. The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for (a) Ends of dissimilar materials such as joints, beams, posts, girders, falters, purling trusses, corbels and steps etc., up to 500 Sq. Cm. in section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing centre of specified strength. The rate excludes the cost of form work.

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

Item No. :- 33

Providing and laying filter media 600mm thick as directed at the back of abutment return & wing wall as per detailed specification.

PITCHING / REVETMENT ON SLOPES

Description

This work shall consist of covering the slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer of granular material called filter. While river side slopes are given this protection against river action, the rear slopes, not subjected to direct attack of the river, may be protected against ordinary wave slashing by 0.3-0.6 metre thick cover of clayed or silty earth and turfed.

Pitching / Filter media

2504.2.1 Pitching : The pitching shall be provided as indicated in the drawings. The thickness and the shape of stone pitching shall be shown on the drawing.

The stone shall be sound, hard, durable and fairly regular in shape. Quarry stone should be used. Round boulders shall not be allowed. The stones subject to marked deterioration by water or weather shall not be accepted.

The size and weight of stone shall conform to clause 5.3.5.1 of IRC:89. No stone, weighing less than 40 kg shall, however, be used. The sizes of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.

Where the required size stones are not economically available, cement concrete blocks in M15 grade conforming to Section 1700 or stones in wire crates may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred wherever practicable. Use of geosynthetics has been dealt with in Section 700.

2504.2.2. Filter media : The material for the filter shall consist of sand, gravel, stone or coarse sand. To prevent escape of the embankment material through the voids of the stone pitching / cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching, one or more layers of graded materials, commonly known as a filter medium, shall be provided underneath the pitching.

The gradation of the filter material shall satisfy the following requirements :

Provision of a suitably designed filter is necessary under the slope pitching to prevent the escape of underlying embankment material through the voids of stone pitching/cement concrete blocks when subjected to the attack of flowing water and wave action, etc. In order to achieve this requirement, the filter may be provided in one or more layers satisfying the following criteria:

$$\begin{array}{l} \frac{D_{15}(\text{Filter})}{D_{85}(\text{Base})} < 5 \\ 4 < \frac{D_{15}(\text{Filter})}{D_{15}(\text{Base})} < 20 \\ \frac{D_{50}(\text{Filter})}{D_{50}(\text{Base})} < 25 \end{array}$$

Notes :

1. Filter design may not be required if embankment consists of CH or Ch soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching.

2. In the foregoing, D 15 means the size of that sieve which allows 15 per cent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85.
3. If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
4. The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

2504.3. Construction Operations

Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and a uniform slope throughout. Depressions shall be filled and thoroughly compacted.

The filter granular material shall be laid over the prepared base and suitably compacted to the thickness specified on the drawings.

The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3, in case of dry rubble pitching and shall be in nominal mix cement concrete (M 15) conforming to Clause 1704.3 in case of cement concrete block pitching.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals and all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

2504.4 Toe Protection

In conformity with clause 5.3.7. of IRC:89, a toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to protect the slope pitching from galling even when the apron is not laid at low water level. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3 in case of dry rubble pitching or pitching / revetment with stones in wire crates and in nominal mix cement concrete (M 15) conforming to Clause 1704.3 in case cement concrete blocks have been used in pitching. For protection of toes of bank slopes terminating either in short aprons at bed levels or anchored in flooring / rocky bed, the provisions of clause 8.2.2 of IRC:89 may be complied with. The relevant specifications of the protective works for individual components will be followed.

Mode of Measurement :-

Payment shall be made on Sqmt basis.

Item No. :- 34

Providing and laying weep holes in abutments, and returns by using A.C. / PVC Pipe of 100mm including laying in proper grade and jointing the complete as per detailed specification.

(1) GENERAL :

The Weep holes in the masonry / mass cement concrete of abutment and returns shall be provided of the PVC pipe 110mm dia pipe. The pipe shall be fixed of suitable length and in full thickness of the masonry / concrete work. Necessary i.e. grating shall be provided on back side of abutment and returns on the inlet of opening of weep holes.

(2) MATERIALS :

The PVC pipes of 110mm diameter specified in the description of this item shall confirm to I.S. 1626 – 1900. The interior of pipe shall have a smooth finish, regular surface and regular internal diameters.

(3) The tolerance in all dim. shall be as per I.S. 1926 – Part – I 1980.

(4) The grating shall be C.I. 100mm dia and as per I.R.C. Specification.

(5) Workmanship :

The weep holes shall be provided at 1 MT. C/C and shall be placed in staggered. After laying weep holes, it shall be clear of earth and other materials from its complete length.

(6) Payments :

The rate of payment of this items shall be on 1-No. basis of complete item.

Item No. :- 35

Earthwork for embankment including breaking clods, dressing with all lead and lift (Excluding rolling & watering) (E) From borrow area with 3 Km. lead

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30cm 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 meters lead, and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighbourhood. In all cases, the materials shall be disposed off in a neat manner.
2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing, Bench marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.
3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The materials 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 section 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 either side with all lead and all lifts and within land width in the manner specified in para 11 bellow. 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 of 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 250mm 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 15cm. When being placed in the embankment and a maximum of size 5cm when being placed in the top 45cm 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 5cm 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 0.1m 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 50mm so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment wing walls of culverts bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures upto 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, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections, longitudinal section etc. in token on 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 leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. deduction of 15% for shrinkage shall be made from gross measured quantity if measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any that might have taken place at the time of taking final measurements of the item.

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

- (i) The borrow pits will be so excavated as to from a road side longitudinal gutter to drain the water, interrupted by such gutter.
- (ii) The width of the drain shall be restricted to 1.5mts, only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.

Item No. :- 36

Providing and laying 150mm thick Granular sub base by providing coarse graded material grading - II using B.T. M.C. metal crushed stone aggregates 26.5 mm to 4.75 mm @ 75% & below 2.36 mm as per table 400-2 of MORTH Fifth Revision gradation including levelling the material at site of work, mixing & spreading into grade and camber, watering & consolidation at O.M.C. with vibratory roller including cost of material, labour, etc. complete.

501 GRANULAR SUB-BASE**403.1 Scope**

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

403.2. Materials

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

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

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

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

IS sieve Designation	Percent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR value (Minimum)	30	25	20

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

IS sieve Designation	Percent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	

26.5 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR value (minimum)	30	25	20

402.3 Strength of Sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

402.4. Construction Operations

402.4.1. Preparation of subgrade: Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 – 100 kN smooth wheeled roller.

402.4.2. Spreading and Compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mixture in-place method.

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

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above or 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum of pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7MN/m or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super-elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high