

**Construction of Khamnath Bridge in place of existing damaged arch bridge on River Ghee on Khambhalliya Porbandar Road in Khambhaliya Nagar Palika Limit on new alignment.**

**DETAIL TECHNICAL SPECIFICATION**

**Item No 1:- Dismantling the existing structure R.C.C. work including removing and stacking the dismantled materials as and where directed.**

1. This work shall consist of removing as here in after forth, existing culverts, bridges, pavements, kerbes and other structures like guardrail, fences utility poles, manholes, catch basins, inlets etc. Which are in place but interfere with the new constructions or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.
2. Existing culverts. Pavements and other structures which are within the highway and which are designated to be removed shall be removed up to the limits and extent specified in the drawings or as indicated by the Engineer-in-charge.
3. Dismantling and removal operations shall be carried out with equipment and in such a manner as to leave undisturbed. Adjacent pavement, structures and any other work to be left in place.
4. All operations necessary for the removal of any existing structure, which might endanger new. Construction shall be completed prior to the start of new work.
5. The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged. the part of the structure to be retained and any other properties or structures nearby.
6. Unless otherwise specified the superstructure portion of culverts/bridges shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the interference they cause they cause to the new construction. Removal of overlying or adjacent material if required in connection with the dismantling of the structures, shall be incidental to this item.
7. Where existing culverts/bridges are to be extended or otherwise in the new work, only such part of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars, which are to be left in place so as to project into new work as dowels or ties, shall not be injured during removal of concrete.
8. Pipe culverts shall be carefully removed in such a manner to avoid damage to the pipes.
9. Steel structures shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. if specified in the drawing or directed by the Engineer -in-charge that structure is to be removed in a condition suitable for re-erection, all members shall be match marked by the contractor with white lead paint before dismantling end pins, nuts loose plates, etc shall be similarly marked to indicate their proper location, all pins, pin holes and machined surfaces shall be painted with a mixture of white lead and all loose parts shall be securely wired to adjacent members or packed in boxes.
10. Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber as is designated to be salvaged by the Engineer-in-charge.
11. In removing pavements, kerbs, gutters and other structures like guard rails, fences, manholes, catch basins, inlets, etc where portions of the existing construction are to be left in the finished work the same shall be removed to an existing joint or out and chipped to a true line with a face perpendicular to the surface of the existing strata. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer –in-charge.
12. All concrete pavements, base course in carriage way and shoulders etc. designated for removal shall be broken to pieces whose volume shall not exceed 0.20 cubic meter and stockpiled at designated locations if the material is to be used later or otherwise arranged for disposal as directed.
13. Where directed by the Engineer -in-charge holes and depressions by dismantling operations shall be backfilled with excavated or other approved material and thoroughly compacted in line with surrounding area.
14. Credit of dismantled material will be deducted from 1st R.A. Bill
15. Pipe culverts that are removed shall be cleared and neatly piled on the right-of way at points designated by the Engineer -in-charge.
16. Structural steel removed form old structure shall, unless otherwise specified or directed, to be stored in a neat and presentable manner, Structures or portions there of which are specified in the contract for re-erections shall be stored in separate piles.
17. Timber or lumber from old structure which is designated by the Engineer- in charge materials to be shall have all rails and bolts removed there from and shall be stored in neat piles locations suitable for loading.
18. All the product of dismantling operations which in the option of the Engineer - in-charge cannot be used or auctioned shall be disposed as directed, which 100 meters.
19. The work of dismantling structures shall be paid for in units indicated below by taking measurements before and after, as applicable:

(i)	Dismantling brick/concrete (Plain and Reinforced)	Masonry	Cubic Meter.
(ii))	Dismantling flexible and cement pavement.		Cubic Meter.
(iii))	Dismantling steel structure.		Tone
(iv)	Dismantling timber structure.		Cubic Meter.

(v)	Dismantling pipes guard rails, kerbs, gutters and fencing.	Linear Meter.
(vi))	Utility poles.	Nos.

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

Payment should be done on Cum. basis.

**E. E.**

**Item No 2: - Dismantling the existing structure Rubble Masonry including removing and tacking the dismantled materials as and where directed.**

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

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

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

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

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

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

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

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

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

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

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

12. All concrete pavements, base course in carriage way and shoulders etc. designated for removal shall be broken to pieces whose volume shall not exceed 0.20 cubic meter and stockpiled at designated locations if the material is to be used later or otherwise arranged for disposal as directed.

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

14. Credit of dismantled material will be deducted from 1st R.A. Bill

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

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

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

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

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

(i)	Dismantling brick/Rubble/concrete (Plain and Reinforced) Masonry	Cubic Meter.
(ii))	Dismantling flexible and cement pavement.	Cubic Meter.
(iii)	Dismantling steel structure.	Tone
(iv)	Dismantling timber structure.	Cubic Meter.
(v)	Dismantling pipes guard rails, kerbs, gutters and fencing.	Linear Meter.
(vi)	Utility poles.	Nos.

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

Payment should be done on Cumt. basis.

## **E. E.**

**Item No 3:- Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials by mechanical means in area of light jungle.**

### **1 GENERAL: -**

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 300mm 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, structure and such other areas as may be specified by the Engineer. It shall include necessary excavation, back-filling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Cleaning and grubbing shall be performed in advance of earthwork, operations and in accordance with the requirement of this specification.

### **2 Preservation of property / Amenities: -**

Road side trees, shrubs and other plants, pole, lines, fences, signs, monuments, buildings, pipe lines, sewers and all highway facilities within or adjacent to be 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 as per Clause 306 of MORTH specification booklet for Roads and Bridge. Before start of operations, the contractor shall submit the engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedule for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3 of MORTH specification booklet for Roads & Bridges.

### **3 Methods, Tools and equipment :-**

Only such methods, tools and equipment's as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the work. If there is thick vegetation / roots / trees a crawler or pneumatic tired dozer adequate capacity may be used for clearance purpose. 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

500mm of the sub-grade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment / sub-grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, tress 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 excavation below the general ground level arising out of the removal of trees, stumps etc. shall be filled within suitable materials and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

#### **4. Disposal of materials:-**

All materials arising from clearing and grubbing operation shall be the property of the government and shall be disposed by the Contractor as herein after provided or as directed by the Engineer-in-charge.

Trunks, branches and stumps of trees shall be cleared 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 lead and lifts.

All products of clearing and grubbing which in the opinions of the Engineer, cannot be used or auctioned shall be cleared away from the road sides 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 likely hood of these getting mixed up with the materials meant of embankment, sub-grade and road construction.

#### **5 Measurement for payments :-**

Clearing and grubbing for road embankment, drains and cross drainage structure shall be measured on area basis in terms of Hectares. Clearing and grubbing of borrow area 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 tress up to 300mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps left over after trees have been cut at any other agency shall also be considered incidental to the clearing and grubbing operations.

#### **6 Rates :-**

The contract unit rate for this item of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300mm 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 off the cleared materials with all lead.

The contractor unit rate for cutting (including removal of stumps and roots) of trees of girth above 300mm shall include excavation and back-filling to required compaction, handling, salvaging, piling and disposing of the cleared materials with all lead and lift.

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

**E. E.**

**Item No. 4:--Marking out the centre line of the Bridge and various other component structures and complete lining out and levelling with theodolite, levels, including constructing necessary masonry pillars for lines and levels and establishing necessary bench marks etc. complete as directed and maintained it till completion of superstructure.**

1.0 The Contractor shall establish working bench marks tied with the Reference bench mark in the area soon after taking possession of the site. The Reference bench mark (RCC Pillar) for the area shall as per GPS or Survey of India and it must be verified by Engineer. The working bench marks shall be at the rate of four per km and also at or near all foundation structures. Checks must be made on these bench marks once every month and adjustments, if any, got approved from the Engineer and recorded. An up-to-date record of all bench marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record. Latest Instrument like Total Station/ DGPS associated with Level Instruments have latest up to date calibration certificate.

1.1 The lines and levels of Foundation level, pier top, pier cap and super structures, formation, side slopes, drainage works, carriageways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.

1.2 No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall commence until the center line has been referenced.

1.3 The Contractor will be the sole responsible party for safe-guarding all survey monuments, bench marks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out the centre line. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions and levels.

The construction staking shall be done by personnel who are trained and experienced in construction layout and staking of the type and kind required in the Contract.

Field notes shall be kept in standard, bound field notebooks as approved by the Engineer in charge. Field notes shall be subject to inspection by the Engineer and shall be the property of the Employer.

The Contractor shall correct any deficient staking or construction work which resulted from inaccuracies in the staking operations or from the Contractor's failure to report inaccuracies in the plans or survey data furnished by the Department.

1.4 After obtaining approval of the Engineer, work on earth work in excavation can commence and maintain as per approved drawing.

1.5 Precision automatic levels, having a standard deviation of  $\pm 2$  mm per km, and fitted with micrometer attachment shall be used for all double run levelling work. Setting out of the road alignment and measurement of angles shall be done by using Total Station with traversing target, having an accuracy of one second.

## **E. E.**

**Item No. 5:--Providing and installation of barricading with retro- reflective paint / film / tapes as specified in the drawing @ 3m high with 50x50x6mm angle, 450mm deep M15 concrete embedment, with vertical angle at 3m c / c spacing, marking Mandatory and information details, Speed limit, Work in Progress etc. along the construction site the construction of bridge, along with necessary diversion arrangement for existing traffic movement in an unobstructed condition, all relevant markings , sign boards and illumination as per relevant MORT & H specification. Rate to be inclusive of all materials, fabrication works, paint works, foundation works, transportation, loading unloading, installation, removing & relocating and inclusive of all taxes and including the same. design for providing openable gates include all safety features No extra rental will be given to the contractor in case of any delays from his part for construction or due to any valid time limit extensions. Each barricading sheet is to be numbered with a unique number. The contractor may reuse the same sheet for barricading elsewhere with in the project boundaries however in such case, he will not be titled for separate rent for reuse After the completion of project, the owner ship of barricading will remain with the contractor. Blinkers are to be installed on the barricading at critical locations. Barricading is to be cleaned by means of washing with water on a weekly basis or a sand when required as per the instructions of Engineer in charge.-**

### **1901 DESCRIPTION**

This work shall include furnishing, fabricating, transporting, erecting and painting structural steel, rivet steel, cast steel, steel forgings, cast iron and other incidental metal construction of the kind, size and quantity in conformity with the drawings and these Specifications or as directed by the Engineer.

### **1902 GENERAL**

General requirements relating to the supply of material shall conform to the Specifications of IS:1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

.1904.10 Welding

**1904.10.1** All welding shall be done with the prior approval of the Engineer and the workmanship shall conform to the specifications of the relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precautions like pre-heating shall be taken as laid down in IS:9595. Surfaces and edges to be welded shall be smooth, uniform and free from fins, tears, cracks and other discontinuities. Surface shall also be free from loose or thick scale, slag rust, moisture, oil and other foreign materials. Surfaces within 50 mm of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding.

The general welding procedures including particulars of the preparation of fusion faces for



metal arc welding, shall be carried out in accordance with IS:9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be as per details shown on the drawings and shall be submitted in writing for the approval of the Engineer, in accordance with Clause 22 of IS:9595, before commencing fabrication.

Any deviation from this procedure has to be approved by the Engineer. Preparation of edges shall, wherever practicable, be done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planing and shall be left free of slag. Manual flame cutting shall be permitted by the Engineer only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant Indian Standards mentioned in Clause 1903.2.3. Procedure test shall be carried out as per IS:3613 to find out suitable wire-flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of Clauses 14 to 16 of IS:9595.

Welded temporary attachment should be avoided as far as possible. If unavoidable, the method of making any temporary attachment shall be as approved by the Engineer. Any scars from temporary attachment shall be removed by cutting and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

Welding shall not be carried out when the air temperature is less than 10°C, when the surfaces are wet, during periods of strong winds and in snowy weather, unless the work and the welding operators are adequately protected.

**1904.10.2** For welding of any particular type of joint, welders shall undergo the appropriate welders qualification test as prescribed in any of the relevant Indian Standards IS:817, IS:1966, IS:1393, IS:7307 (Part I), IS:7310 (Part I) and IS:7318 (Part I) to the satisfaction of the Engineer.

**1904.10.3** In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as to avoid distortion and minimize shrinkage stress.

All requirements regarding pre-heating of parent material and interpass temperature shall be in accordance with provisions of IS:9595.

Galvanized sheet:

The galvanized sheet 0.80 mm as per M-221 shall be used for closing the frame of barricading work as directed by engineer-in-charge.

## **1906 PAINTING**

### **1906.1 General**

Unless otherwise specified, all metal work shall be given approved shop coats as well as field coats of painting. The item of work shall include preparation of metal surfaces, application of protective covering and drying of the paint coatings along with all tools, scaffolding, labour and materials necessary. Coatings shall be applied only to dry surfaces and the coated surfaces shall not be exposed to rain or frost before they are dry. The coatings shall be applied to all surfaces excluding shear connectors and inner surfaces of fully sealed hollow sections. While coating adjacent surfaces, care shall be taken to ensure that primer is not applied on the shear connectors.

### **1909 RATE**

The contract unit rate for the completed barricading work shall include the cost of all materials, labour, tools, plant and equipment required for fabrication, connections, oiling, painting, temporary erection, inspection, tests and complete final erection as shown on the drawings or as directed by the Engineer and as specified in these Specifications.

The payment shall be made on Sqm. Basis for finished work.

**E. E.**

**Item No. 6:--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. With all lead and lift.**

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

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stories, lime, mortar, concrete, etc. required in connection with the setting out of works and the establishment of bench

mark, center line stones and other marks and stakes as long as in the opinion of the Engineer-in-charge, they are required for the work.

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

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

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

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

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

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

9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue 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 to be used in the construction of embankment, it shall be directly deposited at the required location, within 100 meters lead.

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

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

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

1. Setting out and fixing bench marks and center lines stones.
2. Construction of necessary shoring and bracing and their subsequent removal.
3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, clearing up the site and disposal of all surplus material within all lifts and lead up to 100 meters.

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 vegetation or organic soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum a mixture of these and similar material which yields to the

ordinary application of pick and shovel, or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm. occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

#### **E. E.**

#### **Item No 7:- Excavation in hard rock by dry-wet blasting and chiselling including dewatering preparing foundation base by proper benching and stepping and disposing of the excavated stuff as directed. With prohibited Blasting work**

1. Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements, of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall include all necessary sheeting, shoring, bracing, draining and Pumping and the removal of all logs, stumps, shrubs, and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stories, lime, mortar, concrete, etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as in the opinion of the Engineer-in-charge, they are required for the work.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be as shown on the drawings; unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
5. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing pumping, to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however not relieve the contractor of the responsibility for the adequacy of dewatering, and production arrangements and for the quality and safety of the works.
6. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No. pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing, is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these shall be removed by the contractor at his own cost.
8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.
9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue 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 to be used in the construction of embankment, it shall be directly deposited at the required location, within 100 metres lead.



11. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 100 metres lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic metres for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.
13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including :-
1. Setting out and fixing bench marks and centre lines stones.
  2. Construction of necessary shoring and bracing and their subsequent removal.
  3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
  4. Foundation sealing, dewatering including pumping;
  5. Backfilling, Clearing up the site and disposal of all surplus material within all lifts and lead upto 100 metres.
  6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.
14. Excavation shall be in any rock or boulders having diameter in any one direction of more than 300 mm. for which the use of the Engineer-in-charge and his decision shall be final and binding on the contractor. merely the use of explosive will not be considered as a reason for higher classification unless blasting is clearly necessary in opinion of the Engineer-in-charge.
15. Where blasting is prohibited for any reason, chiseling shall carry out excavation, wedging or any other approved method.
16. Blasting shall be carried out only with the written permission of the Engineer-in-charge. All the statutory laws, regulations, rules, etc. pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.
17. The contractor may adopt any method or methods of blasting consistent with safety and job requirement, after approval from the Engineer-in-charge.
18. The magazine for the storage of explosives shall be build to the design and specification of the Explosives Department concerned and located at the approved site. No unauthorized person shall be admitted in to the magazine which when not use shall be kept securely locked. No matches or inflammable materials shall be allowed in the magazine shall have any effective lightening conductor. The following shall be hung in the lobby of magazine.
- (a) A copy of the relevant rules regarding safe storage both in English and in the language with which the works concerned are familiar.
  - (b) A statement of up to date stock in the magazine.
  - (c) A certificate showing the last date of testing of the lightening conductor.
  - (d) A notice that smoking is strictly prohibited.
19. In addition to these, the contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer-in-charge and shall be responsible for damage to property and any accident which may occur to workmen or the public on account of any operations connected with the storage handling of use explosive and blasting. The Engineer-in-charge shall frequently check the contractor's compliance with these precautions.
20. All the materials, tools, and equipment used for blasting operations shall be of approved type. The Engineer-in-charge may specify the type of explosive to be allowed in special cases. The fuse to be used in wet locations shall to sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the fiver to reach to place of safety before explosion takes place. Detonators shall be capable of giving effectives blasting of the explosives. The blasting powder, explosive, detonators, fuses etc. shall be fresh and not damaged due to damp, moisture, or any other cause. They shall be inspected totally and removed immediately, if found unsuitable.
21. The blasting operation shall remain in charge of competent and experienced supervisory staff and workmen who are thoroughly acquainted with the details of handing explosives and blasting operations.
22. The blasting shall be carried out during fixed hours of the day preferably during the mid-day inch eon hour or at the close of the work as ordered in writing by the Engineer-in-charge. The hours shall be made known to the people in the vicinity. The man in charge shall prepare all the charges only.

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

24. The charge holes shall be drilled in suitable places to required depths. Blasting should be as light as possible consistent with thorough breakage of the materials necessary for economic loading and handing. Any method of blasting which leads to over shooting shall be discontinued.

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

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

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

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

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

(2) If it is the blasting powder charge it shall be completely flooded with water A new hole shall be drilled at about 45 cm. form the old hole and fired. This should be repeated till the old charge is blasted.

(3) In case of charges of gelatine, dynamite etc the man in charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge.

Alternatively, the hole may be cleared of 30cm.of tamping and the direction then ascertained by placing a stick in the hole. Another hole may than be drilled 15cm. away and parallel to it. This hole shall than be charged fired when the misfired hole should explode at the same time. The man in charge shall at once report to the contractor's officer and Engineer-in-charge all cases of misfire, the cause of the same and what steps were steps were taken in connection therewith.

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

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

31. Excavation shall be measured after removal of over burden by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in cubic meters by the method of average and areas. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits. the volumes shall be computed by other accepted method. At the option of the Engineer-in-charge, the contractor shall leave depth indicators during excavations of such shape and size, and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken. Where cross sectional measurements, could not be taken due to be computed on the basis of stacks of excavation rubble after making 40 per cent deductions there from.

The payment shall be made on Cumt. basis.

From the total excavated hard rock stuff half of the stuff shall consider usable stuff and shall be used by the contractor for this work or other work and shall be recover from the bill of contractor for this work at current schedule of rates of this division at the time of work.

**E.E.**

**Item No. 8:- Excavation for foundation in hard murrum and boulders and very stiff or sticky, clays and other similar strata including shoring and strutting and dewatering as necessary and disposing of the excavated stuff as directed.**

1. Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements, of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall be including all necessary sheeting, shoring, bracing, draining and Pumping and the removal of all logs, stumps, shrubs, and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stories, lime, mortar, concrete, etc. required in connection with the setting out of works and the establishment of bench mark, center line stones and other marks and stakes as long as in the opinion of the Engineer-in-charge, they are required for the work.
3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer-in-charge.
4. The depth to which the excavation is to be carried out shall be shown on the drawings; unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
5. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing pumping, to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however not relieve the contractor of the responsibility for the adequacy of dewatering, and production arrangements and for the quality and safety of the works.
6. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No. pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing, is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these shall be removed by the contractor at his own cost.
8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective, measures to see that the excavation operations do not affect or damage adjoining structures.
9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue 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 to be used in the construction of embankment, it shall be directly deposited at the required location, within all lead.
11. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within all lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic meters for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.

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

1. Setting out and fixing bench marks and center lines stones.
2. Construction of necessary shoring and bracing and their subsequent removal.
3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, Clearing up the site and disposal of all surplus material within all lifts and lead.
6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.

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

**E. E.**

**Item No. 9:- Excavation in large boulders and soft rock by welding including shoring, strutting and dewatering as necessary and disposing of the excavated stuff as directed.**

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

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stories, lime, mortar, concrete, etc. required in connection with the setting out of works and the establishment of bench mark, center line stones and other marks and stakes as long as in the opinion of the Engineer-in-charge, they are required for the work.

3. Excavation shall be taken to the with 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 personal and works and to the satisfaction of the Engineer-in-charge.

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

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

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

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

8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall

take adequate protective, measures to see that the excavation operations do not affect or damage adjoining structures.

9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue 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 to be used in the construction of embankment, it shall be directly deposited at the required location, within all lead.

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

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

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

1. Setting out and fixing bench marks and center lines stones.
2. Construction of necessary shoring and bracing and their subsequent removal.
3. Removal of all logs, stumps, shrub and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, Clearing up the site and disposal of all surplus material within all lifts and lead.
6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.

14. Excavation shall be in soft rock or such as lime stone, sand stone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or spilt with crow bars, boulders which do not require blasting having diameter in any direction of more than 300 mm and any rock which in dry state may be hard, requiring blasting but which when wet become soft and manageable by means other than blasting. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor

**E.E.**

**Item No. 10:- Providing and fixing mild steel dowel bars of minimum 32mm dia. for anchoring by drilling holes in foundation strata including necessary bending, hooking of dowel bars and grouting the holes complete as per detailed drawing and as directed.**

1. This item provides for necessary mild steel bars of 32 mm dia, for anchoring in foundations strata as per details drawing and as directed by Engineer-in-charges. For this purpose, 100 mm holes shall be kept in steining itself at regular intervals as shown in drawing or as directed by Engineer-in-charges. Mild steel bars shall be supplied by the department at the rate and place shown in schedule-A of the tender. The item includes transporting the bars to the site of works, handling, cutting, bending, hooking and placing the same in position as directed as per drawings. The grout holes shall be not less than 100mm dia,. The anchorage length of bars shall not be less than 60 times dia. of bars. Grounding of grout hole shall be of 1:2 proportion (1 part cement, 2 parts of sand) kept in the well staining to the bottom of the grout holes. Grout holes shall be inserted through holes depth in case, no dowel bars are ultimately decided to be provided in the holes of the staining kept for the purpose, the same be filled with concrete of the same proportion as of well staining at the cost of the contractor.

2. Mode of measurement will be per Rmt. of dowel bar considered as one number from bottom of grout hole to the top of staining.

3. Unit rate include cost of materials labour, tools, and plant and grouting the steining holes to complete the work.

**E.E.**

**ItemNo. 11:- Providing and Casting in situ controlled Cement Concrete M-150 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including necessary shuttering laying, vibrating as per direction of the Engineer-in-charge for Foundation.**

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and



maintained. The controlled concrete shall be in eight grades designated as M.100 M.150, M. 200, M. 250, M.300 M. 350, M. 400 and M. 450 with the suffix controlled added to it.

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubes compressive strength of that mix on 150 mm. cubes, expressed in Kg/cm<sup>2</sup> where ordinary Portland cement conforming to IS: 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page.

Grade of Concrete Compressive works test strength in kg/cm<sup>2</sup> on 150 mm cubes, conducted in accordance with IS '516

		Min. at 7 days	Min. at 28 days	Cement level
M 100	--	70	100	220 Kg.
M 150	--	100	150	290 Kg.
M 200	--	135	200	360 Kg.
M 250	--	170	250	380 Kg.
M 300	--	200	300	400 Kg.
M 350	--	235	350	425 Kg.
M 400	--	270	400	440 Kg
M 450	--	300	450	450 Kg

NOTE :-In all cases, the 28 days compressive strength specified in the above Table shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purposes as a concrete belonging to the lower or the two grades between which its strength lies.

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

4. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.

5. It is most important to keep the specified water-cement ratio constant and its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS: 2386 (Part -III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic meter in plain concrete and not less than 290 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for prestressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it be more than 540 kg/per cubic meter of concrete.

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

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
(i)	R.C.C. well curb, R.C.C. well staining and R.C.C. Piles	40 mm.

(ii)	R.C.C. well staining	63 mm.
(iii)	Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps	40 mm.
(iv)	R.C.C. works in cross girders deck slab, wearing 20 mm. coars, kerb, light posts, blast walls, approach slab etc. and hollow type piers, abutments, wing-walls and their pier caps,	
(v)	R.C.C. bearings.	20 mm.
(vi)	For any other item of construction not covered by items (i) to (v) desired by the Engineer-in -charge in case it is not Specified on drawing.	As specified on the Drawing or as

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.

7. Fine aggregate shall be clean, hard, coarse sand. It shall be free dust and such other substances. The sand be get approved by the Engineer-in-charge,

8. All materials shall be stored as to prevent their deterioration of their quality and fitness for the work, Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

9. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from such other to prevent intermixing the materials.

10. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

11. For all work concrete shall be mixed in a batch mix plant 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.

12. The controlled concrete shall be prepared with batch mix plant established at site with required capacity as directed by engineer-in-charge. The plant shall be certified by Concern Executive Engineer Mechanical Division of that area. The design mix concrete shall be transported with transit mixer of required capacity. No machine mix concrete will be allowed in any circumstances.

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 design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge. Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to be the Engineer-in-charge concrete shall not be dropped two places from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of

cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the 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 layers of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old particular attention being given to corners and close joints.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrator in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

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

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be divided into following two distinct categories

(1) Shuttering i.e. formwork 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. Both shuttering and scaffolding shall be substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface. Only steel form work shall be used.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counteract the effects of any deflection. The formwork shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed-to be the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due to false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are reentrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthening props including the effect or any further additional of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to 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 to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated 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. Surfaces which have been pointed shall be kept moist for a period of twenty-four hours. If rock pockets / honey-combs, 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 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 degrees of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined regular slump tests. Following slump shall be adopted for different types of works.

Type of work	Slumps	
	Where vibrators are used	Where vibrators are not used
i) Mass concrete in R.C.C. foundations, footings and retaining walls	10mm to 25mm	80mm
ii) Beams, slabs and columns simply reinforced.	25mm to 40mm	100 mm to 120 mm
iii) Thin R.C.C. section or section with congested steel	40mm to 50 mm	125 mm 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 meters, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, motor 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 Astt. Engineer /Addi. Astt. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. All necessary labour materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

30. The payment will be made on cumt. basis of the finished work.

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

**E.E.**

**Item No. 12:- Providing and Casting in situ-controlled Cement Concrete M-350 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including necessary shuttering laying, vibrating, ramming and curing complete as per direction of the Engineer-in-charge. for R.C.C. Raft and cut-off walls.**

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M.100 M.150, M. 200, M. 250, M.300 M. 350, M. 400 and M. 450 with the suffix controlled added to it.

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 150 mm. cubes, expressed in Kg/cm<sup>2</sup> where ordinary Portland cement conforming to IS: 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page.

Grade of Concrete Compressive works test strength in kg/cm<sup>2</sup> on 150 mm cubes, conducted in accordance with IS '516

		Min. at 7 days	Min. at 28 days	Cement level
M 100	--	70	100	220 Kg.
M 150	--	100	150	290 Kg.
M 200	--	135	200	360 Kg.
M 250	--	170	250	380 Kg.
M 300	--	200	300	400 Kg.
M 350	--	235	350	425 Kg.
M 400	--	270	400	440 Kg
M 450	--	300	450	450 Kg

NOTE :- In all cases, the 28 days compressive strength specified in the above Table shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purposes as a concrete belonging to the lower or the two grades between which its strength lies.

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of course and fine aggregate shall be checked as frequently as possible, frequency for a given



job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

4. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked. Also, the admixture/super plasticizer shall be added during mixing of concrete as recommended by manufacturer or as per concrete mix design.

5. It is most important to keep the specified water-cement ratio constant and its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS: 2386 (Part -III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic meter in plain concrete and not less than 290 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for prestressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it be more than 540 kg/per cubic meter of concrete.

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

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

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.

7. Fine aggregate shall be clean, hard, coarse sand. It shall be free dust and such other substances. The sand be get approved by the Engineer-in-charge,

8. All materials shall be stored as to prevent their deterioration of their quality and fitness for the work, Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

9. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from such other to prevent intermixing the materials.

10. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

11. For all work concrete shall be mixed in a batch mix plant as below 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.

12. The controlled concrete shall be prepared with batch mix plant established at site with required capacity as directed by engineer-in-charge. The plant shall be certified by Concern Executive Engineer Mechanical Division of that area. The design mix concrete shall be transported with transit mixer of required capacity. No machine mix concrete will be allowed in any circumstances.

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 design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge. Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to be the Engineer-in-charge concrete shall not be dropped two places from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the 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 layers of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old particular attention being given to corners and close sports.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrator in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

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

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delved into following two distinct categories

(1) Shuttering i.e. formwork 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. Both shuttering and scaffolding shall be 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. Only steel form work shall be used.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counteract the effects of any deflection. The formwork shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections

Unless otherwise specified or directed chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed-to be the Engineer- in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where they are reentrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthening props including the effect or any further additional of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to 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 to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated 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 through filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty-four hours. If rock pockets / honey-combs, 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 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 degrees of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined regular slump tests. Following slump shall be adopted for different types of works.

Type of work	Slumps	
	Where vibrators are used	Where vibrators are not used
i) Mass concrete in R.C.C. foundations, footings and retaining walls	10mm to 25mm	80mm
ii) Beams, slabs and columns simply reinforced.	25mm to 40mm	100 mm to 120 mm
iii) Thin R.C.C. section or section with congested steel	40mm to 50 mm	125 mm 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 & day is less than 15 cubic meters, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, 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 Asst. Engineer / Addl. Asst. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of formwork 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 payment will be made on cumt. basis of the finished work.

31. The unit rate for concrete shall include the cost of all materials, labour tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as 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.

**E.E.**

**Item No. 13:- Providing and casting in situ controlled cement concrete M-350 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete for Piers Abutment RCC return.**

1. The work shall in general be carried out as per item No. 12 and the work shall be carried out in controlled concrete m-350 with all required formwork for R C C returns.

**E.E.**

**Item No. 14:- Providing and casting in situ controlled cement concrete M-350 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including controlled cement concrete M-350 bed blocks or pedestals of required size below bearings as per detailed drawings, centering, shuttering, scaffolding, wherever necessary, laying vibrating, curing and finishing complete as per direction of the Engineer-in-charge for R.C.C. work in Pier cap, Abutment cap and Dirt wall.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-350 with all required formwork for R.C.C. work in pier cap, abutment cap and dirt wall.

**E.E.**

**Item No. 15:- Providing and casting in situ controlled cement concrete M-450 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including centering, shuttering scaffolding, ramming, vibrating curing and finishing complete as per direction of the Engineer-in-charge for R.C.C. work in superstructure.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-450 with all required formwork for R.C.C. work in superstructure.

E.E.

**Item No. 16:- Providing and casting in situ controlled cement concrete M-450 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including formwork curing and finishing, complete as per direction of the Engineer-in-charge for Kerb/ kerb blocks.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-450 with all required formwork for Kerb/ kerb blocks.

E.E.

**Item No. 17:- Providing and casting in situ controlled cement concrete M-400 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including tamping, vibrating, finishing, curing and filling in joints with bitumen complete & Providing and laying in position as per direction of the Engineer - in - charge for average 75 mm thick wearing coat laid as directed.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-400 with all required formwork for average 75 mm thick wearing coat.

E.E.

**Item No. 18:- Providing and casting in situ controlled cement concrete M-350 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; including formwork curing and finishing complete as per direction of the Engineer-in-charge for Approach Slab.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-350 with all required formwork for approach slab.

E.E.

**Item No. 19:- Providing & Casting in situ of controlled cement concrete M-350 including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability; as per detailed drawings with necessary reinforcement including, shuttering, laying vibrating and finishing to line and level complete as per direction of the Engineer - in - charge for Parapet.**

1. The work shall in general be carried out as per item No. 12 and The work shall be carried out in controlled concrete m-350 with all required formwork for parapet. And payment shall be made on Rmt. basis

E.E.

**Item No. 20:- Providing and laying precast R.C.C footpath slab in controlled cement concrete of M-200 grade (7.0Cm. thickness including necessary reinforcement and providing and setting cement chequered tiles in C.M. 1:5 as per drawing including necessary formwork, curing and finishing complete.**

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M.100 M.150, M. 200, M. 250, M.300 M. 350, M. 400 and M. 450 with the suffix controlled added to it.

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubes compressive strength of that mix on 150 mm. cubes, expressed in Kg/cm<sup>2</sup> where ordinary Portland cement conforming to IS: 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page.

Grade of Concrete Compressive works test strength in kg/cm<sup>2</sup> on 150 mm cubes, conducted in accordance with IS '516

		Min. at 7 days	Min. at 28 days	Cement level
M 100	--	70	100	220 Kg.
M 150	--	100	150	290 Kg.
M 200	--	135	200	360 Kg.
M 250	--	170	250	380 Kg.
M 300	--	200	300	400 Kg.



M 350	--	235	350	425 Kg.
M 400	--	270	400	440 Kg
M 450	--	300	450	450 Kg

**NOTE :- In all cases, the 28 days compressive strength specified in the above Table shall alone be the criterion for acceptance or rejection of the concrete.**

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purposes as a concrete belonging to the lower or the two grades between which its strength lies.

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

4. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.

5. It is most important to keep the specified water-cement ratio constant and its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS: 2386 (Part -III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic meter in plain concrete and not less than 290 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for prestressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it be more than 540 kg/per cubic meter of concrete.

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

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

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.

7. Fine aggregate shall be clean, hard, coarse sand. It shall be free dust and such other substances. The sand be get approved by the Engineer-in-charge,

8. All materials shall be stored as to prevent their deterioration of their quality and fitness for the work, Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

9. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from such other to prevent intermixing the materials.

10. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

11. For all work concrete shall be mixed in a batch mix plant 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.

12. The controlled concrete shall be prepared with batch mix plant established at site with required capacity as directed by engineer-in-charge. The plant shall be certified by Concern Executive Engineer Mechanical Division of that area. The design mix concrete shall be transported with transit mixer of required capacity. No machine mix concrete will be allowed in any circumstances.

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 design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge. Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to be the Engineer-in-charge concrete shall not be dropped two places from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the 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 layers of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old particular attention being given to corners and close sports.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrator in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out

process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be divided into following two distinct categories

(1) Shuttering i.e. formwork 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. Both shuttering and scaffolding shall be substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface. Only steel form work shall be used.

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counteract the effects of any deflection. The formwork shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed to be the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due to false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are reentrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthening props including the effect or any further additional of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to 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 to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated 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 through filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty-four hours. If rock pockets / honey-combs, 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 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 degrees of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined regular slump tests. Following slump shall be adopted for different types of works.

Type of work	Slumps	
	Where vibrators are used	Where vibrators are not used
i) Mass concrete in R.C.C. foundations, footings and retaining walls	10mm to 25mm	80mm
ii) Beams, slabs and columns simply reinforced.	25mm to 40mm	100 mm to 120 mm
iii) Thin R.C.C. section or section with congested steel	40mm to 50 mm	125 mm 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 & day is less than 15 cubic meters, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete pour. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube-strength. 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specifies strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provided so steel reinforcement in position is not disturbed. For ensuring proper cover, motor 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 Astd. Engineer /Addi. Astd. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

#### **CHEQUERED TILES :**

**47.1.1.** Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below

**47.1.2.** The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The centre to centre distance of chequer shall not be less then 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22 mm

**47.1.3.** The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain coloured or mosaic as specified. The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first grinding with machine before delivery to site.

**47.1.4.** Tiles shall conform to relevant I.S. 1237-1980. 47.5.

**(E) Chequered Tiles For Stair Cases :**

47.5.1. The requirements of these tiles shall be the same as chequered tiles as per (D) above except in following respects :

(1) The length of a tile including nose shall be 300 mm (2) The minimum thickness shall be 28 mm (3) The nosing shall have also the same wearing layer as at the top. (4) The nosing edge shall be rounded (5) The front portion of the tile for a minimum length of 75 mm. from and including the nosing shall have grooves running parallel to nosing and at centers not exceeding 25 mm. Beyond that the tiles shall have normal chequer pattern.

**2.0. Workmanship**

**2.1. Laying :**

The work shall be carried out for skirting or dedo. Before fixing precast Terrazzo (Mosaic marble) tiles of shade and size as specified, the surface shall be prepared by heavy scraping, making joints etc, to the required line, level and plumb. The surface shall be thoroughly wetted before commencing the laying work. Thereafter about 10 mm. thick backing of cement mortar in specified proportion shall be applied on the surface in true line and level generally as per specifications of plaster item.

**2.2. Fixing :**

The back of each tile to be fixed shall be smeared with cement paste of matching colour and the mosaic tiles shall then be gently tapped against the surface, with a wooden mallet. The skirting shall be done only after the flooring is completed. Any pipes coming out of the wall through the dedo or skirting shall only be at the intersection of the horizontal and vertical joints. The tiles shall not have staggered joints. The joints shall be true to entire line both ways and vertical joints shall be in line with joints or flooring. Tiles shall be fixed as close as possible to the adjoining tiles and any difference in the thickness of the mosaic tiles shall be evened out in the cement paste so that all the tiles faces are set in conformity with one another. The skirting shall project uniformly and not more than 6 mm, thickness beyond the finished surface above. Top of skirting or dedo shall be truly horizontal. The risers of steps, skirting or dedo shall rest on top of treads of flooring. Wherever required the tiles shall be cut (sawn) and thin edges smoothened before use.

**2.3. Curing :**

Curing shall be done for 7 days continuously.

**2.4. Finishing:**

Skirting and dedo shall be hand polished to have an even smooth and shining surface. In case of skirting only 10 mm. x 10 mm. groove shall be provided at the junction of cement plaster and cement tiles.

29. All necessary labour materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

30. The payment will be made on Sqm. basis of the finished work.

31. The unit rate for concrete shall include the cost of all materials, labour tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as 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.

**E.E.**



**Item : 21:- Providing and placing in position FE 550D TMT bar reinforcement for all items including cutting bending hooking and tying complete as per detailed drawing.**

## **1.0. GENERAL**

This work shall consist of furnishing and placing TMT Fe500D Conforming to IS 1786- 2008 reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge.

### **2.0. MATERIAL**

#### **2.1. TMT Bars**

Reinforcements shall be T.M.T. Fe500D steel bars. They may be uncoated or coated with epoxy or with approved protective coatings.

**2.2.** T.M.T. bars reinforcement for R C C work shall conform IS 1786 FE-500D 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 placed at an accurate distance from each other and shall be bind tightly to maintain the desired pitch Suitable means shall be provided for holding bars securely in position

#### **4.0. Binding wire**

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

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

**8.4.** In case of dowels for Columns and walls the vertical reinforcement shall be kept in position by means of timber templates with slots in them accurately, or with cover blocks tied to the Reinforcement Timber templates shall be removed after the concreting has progressed up to a level just below their location.

**8.5.** Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals. The minimum diameter of spacer bars shall be 12 mm or: equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be, allowed to sag between supports.

**8.6.** Necessary stays, blocks, metal chairs, spacers, metal hangers supporting wires etc, or other subsidiary, reinforcement shall be provided to fix the reinforcements firmly in its correct position.

**8.7.** Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc. as devices for positioning reinforcement shall not be permitted.

**8.8.** Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic- or plastic-coated binding wires especially manufactured for the purpose.

**8.9.** Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

## **9.0. Lapping**

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

## **10.0 Welding**

**10.1** Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved

by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

**10.2.** While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:  $CE = C + Mn + Cr + Mg + V + Ni + Cu \div 65$  is 0.4 or less.

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

**10.4.** Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, operated by hand or power to attain proper radius of bends. Bars shall not be 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 hook 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 the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any spalling of the concrete.

**10.6.** All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals.

Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be 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 as 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 are maximum.

**10.8.** Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars. The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standard threads. Steel for coupling shall conform to IS 226.

**10.9.** When permitted or specified on the drawings joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points where 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, 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. Specimens shall be taken from

the actual site and their number shall frequency to test shall be as directed by the Engineer in charge.

#### **11.0 MODE OF MEASUREMENTS & PAYMENT**

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

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

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

**11.2.** Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in 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 of 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 unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

**11.5.** The rate shall be for a unit of **One M.T.**

**E.E.**

**Item No 22:- Providing fusion bonded Epoxy coating not less than 175 micron thickness and up to 300 micron to reinforcement bars as per IS-13620-1993/ASTM-775 M including testing of coating at plant and all taxes for any dia. of reinforcement.**

#### **1009.3.2 Coating of Reinforcing Bars**

##### **1009.3.2.1 Fusion Bonded Epoxy Coated Reinforcement**

Fusion bonded epoxy coated reinforcement shall conform to IS:13620 or other international standards as approved by Engineer. The location of the source of supply of the coated bars shall be such as to ensure that the bars are not transported for a distance of more than 300 Km.

Additional requirements for the use of such reinforcement bars are given below:

- a) Patch up materials shall be procured in sealed containers with certificates from the agency who has supplied the fusion bonded epoxy bars.
- a) PVC coated G.I. binding wires of 18G shall only be used in conjunction with fusion bonded epoxy bars.
- b) Chairs for supporting the reinforcement shall also be of fusion bonded epoxy coated bars.
- c) The cut ends and damaged portions shall be touched up with repair patch up material.
- d) The bars shall be cut by saw-cutting and not by flame cutting.
- e) While bending the bars, the pins of work benches shall be provided with PVC or plastic sleeves.
- f) The coated steel shall not be directly exposed to sun rays or rains and shall be protected with opaque polyethylene sheets or such other approved materials.
- g) While concreting, the workmen or trolley shall not move directly on coated bars but shall move only on

wooden planks placed on the bars.  
The work shall be carried out with all tool, plants, equipment's, chemicals and transportation from factory to site without any damage and for all dia. of bars.  
The payment shall be made on MT basis for reinforcement used.

### E.E.

#### **Item No 23:- Providing and fixing in position fully moulded restrained elastomeric Bearings as per detailed drawings.**

1. The term 'bearings' in this case shall refer to an elastomeric bearing consisting of one or more elastomer slabs bonded to metal plates during manufacture so as to form a sandwich arrangement, while 'Bearings Pads' shall denote single unreinforced elastomer slabs.
2. The elastomer to be used for bearings shall be made from natural or synthetic rubber and satisfy the physical properties given below. The test pieces required for the tests shall be selected from the centre layer of the bearings while making up the selection.

	ITEMS	ASTM Designation	Requirement
(i)	Durometer Hardness	D-2240	55 to 70 (# 5 points for the nominated value)
(ii)	Ultimate Tensile Strain per cent	D-412	450 for 55 grade 400 for 60 grade 300 for 70 grade
(iii)	Tensile Strength Kg/cm <sup>2</sup>	D-412	175 minimum 135 minimum for natural rubber of hardness greater than 65.
(iv)	Adhesion to Metal Kg/cm	D-429 (Method-B)	9
(v)	Tear Resistance Kg/cm.	D-624 40 (DIEC)	
(vi)	Compression set 22 hrs. At 70° C. %	D-395 (Method-B)	25 maximum
(vii)	Ozone resistance 22% strain 100 hrs. at 380° C. +10 °C (1 part per million in air by volume).	D-1149	No cracks.
(viii)	Accelerated ageing 70 hours, 100 °C Hardness increase Tensile strength reduction, elongation at break reduction.	D-573	10 points 15% of original. 25% of original.
(ix)	Low temperature stiffness young's Modulus-40 °C Kg/cm <sup>2</sup> .	D-797	700 maximum.

3. Adhesive used in bearing location v attachment to bridge decks shall be subject to the approval by the Engineer-in-charge. It shall be of high viscosity resins, which are cold setting and free of solvent. Adhesive shall not be used to bond layers of cured elastomer. Mild steel used for plate reinforcement shall comply with the requirements of relevant. I.S. The Contractor shall furnish to the Engineer-in-charge a certificate by the Manufacturer that the elastomer and fabric (if used) in the elastomeric bearing conforms to all the above requirements. The certification shall be supported by a certified copy of the results of tests, performed by the Manufacturer upon samples of the elastomer and fabric to be used in the bearings.

4. The thickness of a single layer bearing shall not exceed 20 per cent of the least plan dimension. The total thickness of a laminated bearing shall not exceed 40 per cent of the least plan dimension. The thickness of any internal layer of elastomer shall not be less than 6 mm. nor greater than 12 mm. The thickness of outer plates shall be not less than 3 mm. and that of inner plate not less than 1.5 mm. Metal plates in which dowels are located shall be, in general, not less than 6 mm. thick. The edges of all plates shall be lightly rounded to approximately 5 mm. radius. The metal plates referred above should not be composed of thinner plates joined together. Laminated Bearings shall have side cover of elastomer of minimum thickness of 6 mm. to protect the ends of the steel plates and to give a reduced surface strain to that occurring at the edge of the bonded plates but shall not be considered in evaluation of deformations. The cover of elastomer at the top and bottom surfaces shall not be less than 3 mm. or more than half the thickness of internal layer. The outer cover at top and bottom surfaces having thickness less than half that of a single internal layer and not exceeding 3 mm. may be considered as a simple protection and need not therefore be considered in calculating deflections. Where above elastomer covers are provided, there is no objection to keeping the thickness of top most and bottom most plates same as that of inner plates.



5. Bearing shall be set back from the edge of a bearing surface a distance not less than the thickness of the layer of elastomer in contact with bearing surface to allow for spreading of the elastomer under load. Bearings may be located in position by means of dowels or studs or other devices, or bonded to the structure with approved adhesives which shall generally be of the high viscosity resin type cold setting and free from solvent. For spans on an inclined grade and without hinge bearings the sole plates shall be provided and the same bevelled so that masonry surfaces and the bearing shall be kept horizontal. To facilitate maintenance, the ends of trusses and plate girders shall preferably be supported on plates or pedestals so that there is at least 15 centimetres clearance between the bottom chord or flange and the substructure. The plan dimensions of the bearings to be finally adopted shall preferably be selected from series 'R' 20 of IS : 1076. The arrangement of placing only one bearing under a girder shall be permitted. Further, bearings of different sizes must not be placed next to each other to support a span. The bearings shall be fully moulded when metal laminations are used. These laminated elastomeric bearings shall consist of one or more elastomer slabs bonded to metal plates so as to form a sandwich arrangement. Such fully moulded bearings shall be manufactured to required size. The bond between elastomers and metal or fabric shall be such that, when a sample is tested for separation, failure shall occur within the elastomers and not between the elastomer and metal.

6. The contractor shall get the bearings tested for the physical properties and performance of bearings. The test pieces required for the test shall be selected from the Central layer of bearing making up the selection. For the Size of the test pieces and method of tests etc. the relevant A.S.T.M. Standard shall be followed. The tests shall be carried out in a recognised laboratory acceptable to the department for all the necessary tests required by the Department. The specimen for tests as may be required shall be supplied by the contractor at his own cost and the testing charges shall also be fully borne by the contractor. Only those bearings which pass the tests satisfactorily will be accepted and will be permitted to be used. The Department shall not accept any responsibility for the cost of bearings rejected.

- |    |       |  |           |
|----|-------|--|-----------|
| 7. | (i)   | Tolerances on length and width   | 0, + 5mm. |
|    | (ii)  | Tolerances on thickness for single layer pad.  | ± 0.5 mm. |
|    | (iii) | Tolerance on total thickness   |           |
|    |       | 'h' of finished bearings.  |           |
|    |       | 10 < h ≤ 30 mm   | ± 0.5 mm. |
|    |       | 30 < h ≤ 50 mm   | ± 0.8 mm. |
|    |       | 50 < h ≤ 80 mm   | ± 0.9 mm. |
|    |       | 80 < h ≤ 120 mm.   | ± 1.1 mm. |
|    | (iv)  | The parallelism of the individual elastomer laminations for a finished bearing, shall not exceed the tolerances specified at (ii) above when measured at the extremities of the laminations. |           |

8. Proper arrangement shall be made to avoid corrosion of metal plates or deteriorating of adhesive by encasing the bearings totally in elastomer or by some other method approved by the Engineer-in-charge.

9. (i) When bearing assemblies on plates are shown on the drawing to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade and shall be finished by grinding.

(ii) It shall be ensured that bearings are set truly level and in exact position as indicated on the drawings so as to have full and even bearing on the seats. Thin mortar pads (not exceeding 12 mm. ) may be made to meet with this requirements.

(iii) It shall be ensured that the bottoms of the girders to be received on the bearings are plane at the location of these bearings and care shall be taken that the bearing are not displaced while placing the girders.

(iv) Before fixing the elastomeric bearings the concrete surface on which the bearings is to be placed shall be wood float finished to a level plane which shall not vary more than 1.5 mm. from a straight edge placed in any direction across the area.

(v) The position of the bearings shall be accurately marked on the pier/abutment cap and the area where the bearings are to be located levelled accurately.

(vi) The concrete surface shall be free from any loose material and cleared of any grease oil, paint etc., and it shall be dry at the time of fixing.

(vii) The surface of elastomer shall be free any foreign material.

(viii) Once prepared, the concrete or elastomer shall not be touched with bare hand.

(ix) The bearings shall be covered with canvas or a suitable covering material to protect from direct sun-light and weather until the concrete on superstructure is cast.

(x) The bearings shall be fixed in position with epoxy resin adhesive of approved quality.

(xi) The concreting of superstructure shall be taken up only after ensuring that the adhesive for fixing the bearings or pier/abutment cap has set.

10. Unit rate for each type of bearings shall be cubical contents of the bearing measured in cms. The rate for each type of bearings shall include the cost of supplying and fixing the bearings in position complete. The

rate shall also include the cost of samples and their testing as desired by the Engineer-in-charge. The rate shall also include the cost of adhesives for fixing them.

**E.E.**

**Item No 24:- Providing and fixing Modular strip seal expansion joint including anchorage catering to a horizontal movement beyond 70mm and up to 140mm, complete as per approved drawing and standard specifications to be installed by the manufacturer/supplier or authorized representative.**

## **2601 DESCRIPTION**

The work shall consist of fabrication and installation of expansion joints. The filler joint, asphaltic plug joint, compression seal joint and reinforced elastomeric joint of slab seal, strip seal and box seal type shall conform to these Specifications.

## **2602 GENERAL**

**2602.1** The type of expansion joint proposed to be used shall conform to the design and got approved by the Engineer.

### **2606.1 Components**

Strip seal expansion joint shall comprise the following:

i) **Edge Beam** : This shall be either extruded or hot rolled steel section including continuously shop welded section with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further, the configuration shall be such that the section has a minimum thickness of 10 mm all along its cross section (flange and web). Thickness of lips holding the seal shall not be less than 6 mm. The minimum height of the edge beam section shall be 80 mm. The minimum cross sectional area of the edge beam shall be 1500 mm<sup>2</sup>.

ii) **Anchorage** : The edge beams of single strip/box seal joints shall be anchored in the concrete with rigid loop anchorage. The anchor loops shall be connected to the edge beam by means of anchor plate welded to the edge beam. Total cross sectional area of anchor loop on each side of the joint shall not be less than 1600 mm<sup>2</sup> per meter length of the joint and the center to center spacing shall not exceed 250 mm. The thickness of anchor plate shall not be less than 0.7 times the diameter of anchor loop or 12 mm whichever is higher. The anchor loop at the edge profiles should be at right angles to the joint. Planned deviations of this direction are allowable only for the range of 90° ± 20°. The anchoring reinforcement of the construction must lie parallel to the anchor loops.

iii) **Sealing Element** : This shall be a preformed/extruded single strip of such a shape as to promote self-removal of foreign material during normal joint operation. The seal shall possess high tear strength and be insensitive to oil, gasoline and ozone. It shall have high resistance to ageing. The specially designed proprietary type of locking system of seal in the housing of edge beam shall be such as to ensure 100% water tightness as well as ease of installation and replacement. Mechanical fastening of sealing element with edge beam shall not be permitted. Sealing element shall be continuous over the entire joint.

The working movement range of the sealing element shall be at least 80 mm with a maximum of 100 mm at right angles to the joint and

± 40 mm parallel to the joint. Minimum gap for inserting the Chloroprene seals in the expansion joint shall be 25 mm.

### **2606.2 Material**

i) The steel for edge beams shall conform to any of the steel grade equivalent to RST 37-2 or 37-3 (DIN), S235JRG2 or S355K2G3 of EN10025 (DIN 17100), ASTM A 36 or A 588, CAN/CSA Standard G40.21 Grade 300 W and Grade B of IS:2062. For subzero condition, material for steel shall conform to IS:2062 Grade C.

ii) The sealing element shall be made of Chloroprene Rubber (CR). The properties of CR shall be as specified in Table 2600-1.

iii) Anchorage steel shall conform to Grade B of IS:2062 or equivalent standard.

**Table 2600-1 : Properties of Chloroprene Seal**

Property	Standard	Specific Value
Hardness	DIN 53505 ASTM D 2240 *	63 + 5 Shore A 55 + 5 Shore A
Tensile Strength	DIN 53504 ASTM D 412*	Min 11 MPa Min 13.8 MPa
Elongation at fracture	DIN 53504 ASTM D 412*	Min 350% Min 250%
Tear propagation strength longitudinal transverse	DIN 53507 ASTM D 624* (Dia C)	Min 10N/mm Min 10N/mm
Shock elasticity	DIN 53512	Min 25%
Abrasion	DIN 53516	Max 220 mm <sup>3</sup>
Residual compression strain (22h/70°C/30% strain)	DIN 53517 ASTM D 395* (Method B)	Max 28%
<b>Ageing in hot air</b> (14 days/70°C) Change in hardness Change in tensile strength change in elongation at fracture	DIN 53508	Max + 7 Shore A Max – 20% Max – 20%
Ageing in ozone (24h/50pphm/25°C/20% strain)	DIN 53509	No cracks
<b>Swelling behavior in oil</b> (168h/25°C) ASTM oil No. 1 Volume Change Change in hardness ASTM oil No. 3 Volume Change Change in hardness	DIN 53521	Max + 5% Max – 10 Shore A  Max + 25% Max – 20 Shore A
<b>Cold hardening point</b>	ASTM D 1043	Min -35°C

**Note :** \* Only one specification viz., ASTM or DIN shall be followed depending on the source of supply.

#### **2606.3 Fabrication (Pre-installation)**

- i) Rolled steel profiles for edge beams shall be long enough to cater for the full carriageway width. These shall be cut to size as per actual requirements. Alignment of the steel profiles shall then be made on work tables in accordance with the actual bridge cross-section. For this purpose, the contour of bridge cross-section shall be sketched on the tables. After the steel profiles are aligned, these will be fixed to the tables by means of screw clamps and tacked by arc welding.
- ii) Anchor plates shall be cut to the required size by gas cutting. These shall be welded to the edge beams.
- iii) Anchor loops shall be bent to the required shape and welded to anchor plates.
- iv) All steel sections shall be protected against corrosion by either hot dip galvanizing with a minimum thickness of 150 micron or by epoxy coating.
- v) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be given treatment as mentioned in Clause 2605.3 (i).
- vi) The finally assembled joints shall then be clamped and transported to the work site.

#### **2606.4 Handling and Storage**

- i) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- ii) The manufacturer shall supply either directly to the Engineer or to the Contractor all the materials of strip seal joints including sealants and all other accessories for the effective installation of the joint.
- iii) Expansion joint material shall be handled with care. It shall be stored under cover on suitable wooden

padding to prevent damage. Any damage occurring after delivery shall be made good at the cost of Contractor to the satisfaction of the Engineer

**E.E.**

**Item No 25:- Providing and fixing of Tar paper below approach slab as per direction of Engineer in-charge.**

1.0 Tar Paper Bearing shall be placed on the approach of bridge on abutment pier wall. Concrete must be cured for 28 days. After curing period, structure must be dry for 7 days. There should not be any honeycombing, loose grit and surface must be smooth and joints shall be leveled with grinder and undulation shall not be more than 1mm.

2.0 Tar paper shall be 200gsm paper and thickness of bitumen shall not be less than 2mm. If paper is not available, 200 GSM virgin Plastic sheet can be used. Surface must be dry, free from foreign material, concrete surface shall be apply kerosene oil and apply hot bitumen on the surface @ 1.70kg /sqm on the approach and covered all the area where approach slab rest on it. Place Tar paper on the applied area and press uniformly to escape the air and make bond with the hot bitumen. It must in proper level, alignment and grade as per approved drawing.

3.0 While laying shuttering work, reinforcement work, care shall be taken that tar paper shall not damage.

**E.E.**

**Item No 26:- Providing and laying - Filter Media 600mm thick directed at the back of abutments, returns and wing walls as per detailed specifications.**

Well grades pebbled or metal of 40mm to 63mm size shall be used. The grading and tolerances of metal of pebbles shall be as under :-

Sr. No.	No. of size Range	Sieve Designation	Percentage by weight passing through the sieve
1	63mm to 40mm	90mm	100 – 00
		63mm	85 – 100
		50mm	35 – 70
		40mm	00 – 15
		20mm	00 – 05

The size shall be 40mm to 63mm where in tolerance limit for over size shall be up to 15% and that for lower size should be up to 15% and below 20mm. It shall be allowable up to 5%. The filter materials shall be tightly placed to a thickness of not less than 600mm and provided over the entire surface behind abutments, wings or return walls to the full height.

2. The measurement for payment shall be made on Sqm. basis of

3. The unit rate includes the cost of materials, scaffolding labour and tools to complete the work.

**E.E.**

**Item No 27 :- Providing and filling sand behind abutments and between returns in layers as directed.**

1. The sand to be used for filling shall be coarse, granular, clean, free from dust and deleterious matters obtained from a source as approved by the Engineer-in-charge. Sand between returns shall conform to I.S.:383.

2. After the bottom plug has been laid and tested for leakage the level of its top shall be ascertained and recorded and the well shall be filled with sand under water in suitable layers not exceeding 30cm. at a time and each layer well compacted by rodding to maximum density up to the level of the underside of the plug as per details drawing by Engineer-in-charge.

3. Sand between returns and below raft foundations shall be filled in suitable layers not exceeding 30cms. at a time and each layer shall be well compacted.

4. Mode of measurement shall be the total cubical content (in Cum.) of the area covered by sand filling.

5. Unit rate includes the cost of materials, labour and tools and plant to completed the work.

**E.E.**

**Item No 28 :- Steel work , weld in build-up sections framed work including cutting, hoisting, fixing in position and applying a priming coat of red lead paint In beam and joists channels angles tess, flats with connecting plates or angles cleats as in main and cross beams as per approved drawing.**

**1.0. Materials**

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

**2.0. Workmanship**

2.1. The steel sections as specified or required, shall be cut, square and to correct lengths, as per drawings and design. The .cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawing or as directed.

All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in such a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed/permitted.

**2.2.** Steel riveted or bolted in built up sections, frame work.

**2.2.1.** The steel structure as shown in the drawings or as per direction of the Engineer-in-charge shall be laid out on a level platform to full scale and to full size in parts. A steel tape shall be used for measurements to ensure maximum accuracy.

**2.2.2.** Wooden templates 12 mm. to 19 mm. thick or metal sheet template shall be made to correspond to each connecting gussets plate and rivet holes shall be accurately marked on them and drilled. The templates shall be laid on the steel members and holes of the steel members shall also be marked for cutting. The base of steel column and the position of Anchor bolts shall be carefully set out

**2.2.3.** All stiffeners shall be formed by pressure and where practicable the metal shall not to be cut and welded in making these. In major work, or where so specified, shop drawings giving complete details and information for the fabrication of the component parts of the structure including location, type, size, (origin and details or rivets, bolts or weld shall be prepared in advance of the actual fabrication and as distinctly marked or stenciled with paint with the identification mark as given in the shop drawings. The bars shall be thickened at the ends, so as to provide for screwed threads and gradually tapered off to meet their normal section.

Great accuracy shall be observed in fabrication of various member, so that these can be assembled without being unduly packed, stained, or forced into position and when built up, shall be true and free from twists, brinks, buckles, or open joints.

Before making holes in individual members for fabrication the steel work intended to be riveted or bolted together shall be as aligned or clamped properly and tightly so as to ensure close abutting or lapping or the surfaces of the different members. All stiffeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or crossed true and straight and fitted close together. Web splice plates and fillers under stiffened shall be cut to fit within 3 mm. or flange Angles Web plates of Girders shall have no cover. Plates, shall have their ends flush with the top of angles forming the flanges unless otherwise required. The web plates when spliced shall have clearance of not more than 6 mm. The erection clearance for created ends of members connecting steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm. at each end but where for a practical reason greater clearance is necessary, suitably designed seating shall be provided.

Rollers shall be accurately tuned to gauge. These straight and smooth and free from flaws. The roller bearing shall be provided with adequate arrangements for holding the girders or truss resting on it. In columns caps and bases, the ends of shifts together with the attached gussets Angles, channels etc after riveting together shall be accurately mechanized so that the parts connected Butt against each other over the entire surfaces of contact connecting angles or channels shall be fabricated and placed in position with greater accuracy so that they are not unduly reduced in thickness by machining. The ends of bearing stiffeners shall be mechanized or ground to fit tightly both at the top and bottom. All holes shall generally be drilled to the required size and at required position. Sub punching shall be permitted provided it is done 3 mm. or less in diameter and reamer thereafter to the required size. The holes for rivets and bolts shall be larger by 0.4 to 6 mm. than the nominal diameter of rivets or bolts depending upon the diameter of rivets.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes should be clean and accurate holes for counter sunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing.

The fabrication work shall be completed in workshop as far as it is practicable to do so. Site joints shall be done with rivets and fitted bolts or black bolts, as shown in the drawings or as directed. Generally the following principles shall govern the use of rivets turned and fitted bolts, and black bolts.

(i) Rivets and turned and fitted bolts shall be used where the connections is such that slip under load has to be avoided.

(ii) Black bolts may be used very sparingly where a force is carried through a connection without impact, vibration or reversal or stresses.

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

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

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

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

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



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

- (b) Are length voltage and amperage shall be suited to the thickness of material type of groove and other circumstances of the work.
- (c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

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

**2.9.** Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed. Welds and adjacent parts shall not be painted after the same are approved.

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

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

**2.11. Mode of measurements & payment**

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

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

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

2.11.3. The rate shall be for unit of one quintal.

**E. E.**

**Item No. 29:- Providing flood gauge marks on substructure as per design including painting complete.**

1. The width of the flood gauge shall be 60 cm. and will have canary yellow background colour. The flood gauge marking will be in 10 cm. thick strips of alternative black and white colour. The width of the strip shall be as under

- |                     |                       |
|---------------------|-----------------------|
| (a) At every 10 cm. | 15 cm. width          |
| (b) At every 1/2m   | 25 cm. width in black |
| (c) At every meter. | 35 cm. width in white |

The lettering shall be in black colour and of 10 cm. height. The lettering shall show every meter and 1/2 m. level. The lettering shall show levels based on either G.S.T. B.M. or Arbitrary B.M. as furnished by Engineer-in-charge

- 2. All the painting work shall be done in 3 coats. The paint shall be of approved make.
- 3. The measurement for payment shall be on running meter basis measured vertically in height.
- 4. The unit rate includes the cost of materials, labour, painting, equipment if any to complete the work.

**E. E.**

**Item No.30:- Providing masonry steps with Cement Pointing on approaches as directed.**

1. Stones subject to mark deterioration will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than 15 cm.

2. Before laying the stones, the slope of embankment shall be trimmed to the required profile put up to means of lines and pegs to receive the steps and kerb on it. Depression shall be filled and thoroughly compacted. The width of the tread shall be 30 cm. (clear) and shall extend further 15cm. below next tread, thickness of the stone work of the tread shall depend up on the slope of the embankment as under :-

- (a) Slope 1 to 2. 15 cm.

(b) Slope 1 to 3. 10 cm.

The thickness of the stones works shall be uniform through out and shall not be less than the height of the riser depending up on the slope of the embankment as stated above. There shall not be more than 3 stones in the total 45 cms. width of the tread.

3. Kerb of 15cm. width & 25cm. depth, flush with the embankment slope line shall be provided to prevent spilling of earth on the steps. Width of the steps between the Krebs shall be 90 CMS. Unevenness and voids shall be filled with quarry spells and exposed faces of the tread riser and kerb of the stones work shall be cement pointed in proportion as specified so that they are stable and remain in line level. For cement pointing relevant specifications of that items shall apply.

4. The unit rate includes the cost of material, labour and tools including cement pointing to complete the work.

Payment shall be made on No. basis.

**E. E.**

**Item No. 31:- Providing and fixing marble slab Size 75cm x 60cm x 4cm including engraving and painting complete.**

1. Marble plate shall be white and of approved quality and shall be of size as mentioned in the item. Lettering shall be done by V-shape engraving and shall be filled with black paint of approved quality, letting shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed the Engineer-in-charge. Cement shall conform to relevant IS Specification.

2. Measurement shall be per number of marble plate fixed.

3. Unit rates includes cost of all material labour and tools to complete the work.

**E.E.**

**Item No 32:- Providing & laying weep hole in Abutments, and returns by using A.C./PVC pipe of 100mm including laying in proper grede and jointing the completed 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.

**E. E.**

**Item No 33:- Providing G.I. 100mm diameter water spouts including necessary iron gratings as per drawings.**

**(1) GENERAL :**

The Weep holes in the masonry / mass cement concrete of abutment and returns shall be provided of the G.I. 100mm 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 Galvanized iron pipes of 100mm 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.

**(3) 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.

**(5) Payments:**

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

**E. E.**

**Item No 34:- Providing and laying dry stone pitching of 22.5 cm. thick including preparing the surface and cement pointing in C. M. 1 :3 (1cement : 3 Sand) etc complete.**

1. The work shall consist of covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.
2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.

(G.C.No. GSR/2080 IB 547/28/C, dated 6<sup>th</sup> March, 1982)

3. Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and uniform slope throughout. Depressions shall be filled and thoroughly compacted.
4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 mm. Quality of murrum will be as per its relevant specifications.
5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimensions is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panels of 3.0 M x 3.0 M with a 30 CM wide and 8 Cm. deeper band all around.
6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.
7. The rate shall include the cost of preparing the base, putting to the profiles, providing, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour and materials as well as tools and plant required of the work.

**E. E.**

**Item No 35:- Providing panel wall for dry stone pitching in uncoursed rubble masonry with hard stone of approved quality in cement mortar 1:5 including curing etc as complete job.**

1. Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The stones when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS : 1124. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 15 cm.
2. Cement and sand shall be mixed in proportion as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.
3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water the same shall be retempered by adding water as frequently as needed to restore the requisite consistency, but this retempering shall be permitted only, within thirty minutes from the time of addition of water at the time of initial mixing.
4. The dressing of stone shall conform to the general requirements of dressing of stone covered in IS:1129. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a wooden mallet immediately on placement so that it is solidly bedded in mortar before the same has set. Clean chips

and spells shall be edges into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faced completely covered with mortar. Vertical joints shall be staggered as far as possible. Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement. Bell shaped bond stones or headers shall not be used.

5. At all angular junctions, stones at each alternate course shall be well bonded into the respective course of the adjacent wall. All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks are unavoidable, the masonry shall be raked in sufficient long steps to facilitate joining or new work with old. The stepping of taking shall not be more than 45 degree with horizontal wing walls. Abutments and piers etc. shall be carved up truly plumb or with the specified batter. Face work and hearing shall be brought up evenly. The top of each course, however, shall not be levelled up by use of flat chips.

6. Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighbouring stone. The bushing on the face shall not be more than 4 cm on exposed face chips and spalls of stone may be used where necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearing stone to bring these upto the level of ace stone. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearing and they shall not exceed 20 percent of the quantity of stone masonry.

7. The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm. in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in the mortar. The hearting should be laid nearly level with facing and backing. Through bond stone shall be provided in masonry upto 60 cm. thickness and in case of masonry above 60 cm. thickness a set of two or more than bond stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stone (Porous lime stone and sand stones etc.) the bond stone shall extend only about two third into the wall, as through stone in such cases may give rise to penetration of dampness and therefore for all thickness of such masonry a set of two or more bond stones, overlapping each other by at least 15 cm shall be approved. One bond stone or a set of bond stones shall be provided for every 0.50 square metres of the masonry surface. Bond stones shall be stacked separately and marked to distinguish from other stones. Masonry work shall be started after sufficient number of bond stones are collected on site as directed by the Engineer-in-charge.

8. The quoins shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as such as possible and to avoid long vertical lines of joints.

9. The face joints shall not be more than 20mm thick, but shall be sufficiently thick to prevent stone to stone contact and shall be completely filled with mortar.

10. Greenwork shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly wet on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot weather all finished or partly completed work shall be covered for wetted in such manner as will prevent rapid drying. The racking of joints where necessary shall be done at the end of day's work when mortar is green.

11. The scaffolding shall be sound and strong to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

12. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to affect a good with the new work.

13. Stone masonry shall be measured cubic meters.

14. The contract unit for stone masonry work shall include the cost of all labour, materials, tools and plant, Scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above.

## **E. E.**

### **Item No 36:- Labour charges for dry stone pitching of 20 cm. thick including preparing the surface etc. as complete job.**

1. The work shall consist of Labour Work including all Tools, Tackles & Equipment for covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.

2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be

minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.

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

4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 mm. Quality of murrum will be as per its relevant specifications.

5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimensions is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panels of 3.0 M x 3.0 M with a 30 CM wide and 8 CM deeper band all around.

6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.

7. The rate shall include the cost of preparing the base, putting to the profiles, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour as well as tools and plant required of the work.

**E. E.**

**Item No. 37:- Providing and laying cement concrete 1:2:4 (1- Cement : 2- Coarse sand : 4- graded stone aggregates 20 mm nominal size) and curing complete excluding cost of formwork in Foundation and Plinth**

**1.0. Materials:**

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Graded stone aggregate 20 mm. nominal size shall conform to 12.

1.2. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

**2.0. Workmanship:**

**2.7. General:**

2.7.1. The concrete mix is not required to be designed by preliminary tests. 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.

2.7.2. The designation. Ordinary M-100, M-150, M-200, M-250 specified as per I.S. Corresponding approximately to 1:3:6, 1:2:4, 1:1½:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively.

2.7.3. The ingredients required for ordinary concrete containing one bag of cement of 50 Kg. by weight (0.0342 Cum) 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.
1	2	3	4
M-100 (1:3:6)	300 Liters	Generally 1 2 for fine aggregate	34 Liters
M-150 (1:2:4)	220 Liters	to coarse aggregate by volume	32 Liters
M-200 (1:1 1/2: 3)	160 Liters	but subject to and upper limit	30 Liters
M-250 (1:1:2)	100 Liters	of 1 : 1 1/2 and lower limit 1 : 3	27 Liters

2.7.4. The water cement ratios shall not more than those specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be increased to overcome the difficulties of placement and compaction so that the water cement ratio specified in the Table is not exceeded.

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

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

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



2.7.8. 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 bars, or 5 mm. less than the minimum cover to the reinforcement whichever is smaller.

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

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

### **3.0. Proportion of Mix:**

3.1. The Proportion of ' cement, sand and coarse aggregate shall be one part of cement, 2-parts of sand, 4-parts of Crushed stone aggregates and shall so measured by volume.

### **4.0. Mixing**

4.1. 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, cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After about 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.

4.2. 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 water tight 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 placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture to 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.

4.3. 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.

### **5.0 Curing**

5.1 After the final set the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.

### **6.0. Consistency:**

6.1. 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. 1199-1959. The slump of 10 mm. to 25 mm. shall be adopted when vibrators are used and 80 mm. when vibrators are not used.

### **7.0. Inspection:**

7.1. 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.

7.2. 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.

### **8.0. Transporting and laying:**

8.1. 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, (lust, show 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.

8.2. Concreting 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. 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.

**8.3.** Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters. When trunking 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 1.50 rhm, in thickness and shall be well rammed against old work, particular attention being given to corners and close spots.

**8.4.** 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.

#### **9.0. Curing**

Immediately after compaction, concrete shall be protected from weather, including rain, running after shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking, hassain 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.

#### **10.0. Sampling and Testing of concrete**

**10.1.** Samples from fresh concrete shall be taken as per I.S. 1199-1959 and cubes shall be made, cured and tested at 7 days or 28 (lays as per requirements in accordance with LS, 516-1959. 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
1-5 Cmt	1	16-30 cmt.	3
6-15 Cmt.	2	31-50 cfnt.	4
51 and above	4 + one additional for each additional 50 M. 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 the 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.

**10.2.** The average strength of the group of cubes cast for each day shall not be less than the specified cube strength of 150 Kg/Cm<sup>2</sup> it 28 (lays. 20% of the cubes cast for each day may have valueless than the specified strength provided the lowest value is not less than 85% of the specified strength. If the c.r.i4w ma e 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.

#### **4.0. Mode of measurement and payment**

**4.1.** The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed.

**4.2.** The rate shall be for a unit, of one cubic meter.

**E. E.**

**Item No 38:- 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 with all lead and lift.**

1. This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of widening carriageway in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.

2. After the site has been cleared the limits of excavation/ box cutting the road surface shall be set out true

to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer.

3. Box cutting shall be carried out in conformity with the directions laid here in under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from box cutting/ excavation are satisfactorily utilized as directed.

4. The contractor shall not excavate outside the limits of box cutting. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/ dimensions on the drawings shall be made good at the cost of the tractor with suitable material of characteristics similar to that removed and compacted as directed.

5. Cutting shall be done in proper grade & camber as per measurements given. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost) Box cutting for soling and metaling in required width the depth shall be done.

6. Continuous excavation of more than 1 K.M. is not permitted Box cutting is to be done in a staggered manner. Excavation in maximum length of 2 K.M. is permitted in a staggered manner and unless sand filling is started. Further excavation should not start.

7. The stuff received from the cutting shall be utilized for filling cuts and correcting side slopes of bank with all lead and lift as directed. Useful stuff shall be carefully stacked separately as directed.

8. The measurement shall be taken as per cross section measurement of the cutting based on length, breadth, depth measured with tape at every 10 meters interval.

9. The payment shall be made on Cum. basis.

**E. E.**

**Item No 39:- Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T.**

#### **EMBANKMENT CONSTRUCTION**

##### **General**

##### **Description:**

These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

##### **Materials and General Requirements.**

##### **Physical requirements :**

The materials used in embankments, sub grades, earthen shoulders and miscellaneous backfills shall be soil, murrum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment sub grade.

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

- (a) Materials from swamps, marshes and bogs;
- (b) Peat, log, stump and perishable material; and soil that classifies as OL, OI, OH or Pt in accordance with IS:1498;
- (c) Materials susceptible to spontaneous combustion;
- (d) Materials in a frozen condition;
- (e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- (f) Materials with salts resulting in leaching in the embankment.

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

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

constructed out of concrete, cement bound materials or other cementations materials.

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

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

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

**TABLE 300-1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS**

S.No.	Type of work as per IS:2720(Part 8)	Maximum laboratory dry unit weight when tested
1.	Embankments up to 3 meters height, not less than 15.2 kN/cu.m. subjected to extensive flooding.	
2.	Embankments exceeding 3 meters height embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/cu.m. or
3.	Subgrade and earthen shoulders/Not less	than 17.5 kN/cu.m. Verges/backfill

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

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

The materials to be used in sub grade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clause 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Association Committee shall be followed.

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

**General Requirements:**

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

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

**Borrow materials:**

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

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

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

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works

without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

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

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

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

#### **Compaction Requirements**

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

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

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
-----------------------	--

1.	Sub grade and earthen shoulders	Not less than 97%
2.	Embankment	Not less than 95%
3.	Expansive Clays	
	a) Sub grade and 500mm. portion allowed. Just below the sub grade.	Not
	b) Remaining portion of embankment	Not less than 90-95%

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

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

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

#### **Construction Operations :**

##### **Setting Out**

After the site has been cleared to Clause 201, the work shall be set out to Clause

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

##### **Dewatering**

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment

foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the



Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair./restore it to original condition or compensate the damage at his own cost.

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

#### ***Stripping and Storing topsoil***

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

#### ***Compacting ground supporting embankment/Sub grade:***

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

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

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

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 305.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

#### ***Spreading material in layers and bringing to appropriate moisture content***

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

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

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

Moisture content of each layer of soil shall be checked in accordance with IS:2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 per cent above

to 2 per cent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

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

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

Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by

the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

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

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

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

### **Compaction**

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three wheeled roller, self-propelled single drum vibratory roller, tandem vibratory roller, pneumatic type roller, pad foot roller etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

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

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

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

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

### **Drainage**

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

### **Repairing of damages caused by rain/spillage of water :**

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

### **Finishing operations:**

Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause

902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

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

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

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

***Construction of Embankment and subgrade under special conditions.***

**Earthwork for widening existing road embankment :**

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

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

***Earthwork for embankment and subgrade to be placed against sloping ground***

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

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

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

***Earthwork over existing road surface:-***

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

(i) If the existing road surface is of granular or bituminous type and lies within 1 m of the new formation levels, it shall be scarified to a depth of 50mm or as directed so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

(ii) If the existing road surface is of bituminous type or cement concrete type and lies within 1 m of the new formation level, the bituminous or cement concrete layer shall be removed completely.

(iii) If the level difference between the existing road surface and the new formation level is more than 1 m. the existing surface shall be roughened after ensuring that the minimum thickness of 500mm of subgrade is available.

***Embankment and subgrade around structures :-***

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

Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case, not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously

in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

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

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

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

***Construction of embankment over ground incapable of supporting construction equipment.***

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

***Embankment construction under water- and Water-logged areas***

***Embankment construction under water***

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS:1498 and consist of graded,

hard durable particles with maximum particle size not exceeding 75mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

***Embankment construction in waterlogged and Marshy Areas :***

The work shall be done as per IRC:34.

***Earthwork for high embankment :-***

The material for high embankment construction shall conform to Clause 302.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area.

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

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

***Settlement period***

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

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

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

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



**Subgrade Strength**

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

Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on remolded samples, compacted to the field density at the field moisture content and tested for soaked / unsoaked condition as specified in the contract.

**Measurements for Payment**

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

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

The embankment constructed with fly ash will be measured in cum, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the contract.

Construction of embankment under water shall be measured in cum.

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

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

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

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

Scarifying existing granular/bituminous road surface shall be measured in square meters.

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

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

**RATES:**

The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required operations including full compensation for :

- (i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the contract.
- (ii) Setting out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;
- (iv) Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade,
- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contract.
- (xi) All labour, material, tools, equipment and incidentals necessary to complete the work to the Specifications;
- (xii) Dewatering, and
- (xiii) Keeping the embankment/completed formation free of water as per Clause 311.



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

Clause 9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil and of reapplication of topsoil.

Clause 9.2 shall apply as regards Contract unit rate for the item of loosening and recompacting the embankment / subgrade foundation.

Clauses 9.1.1 and 5.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material respectively.

The Contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals, necessary to complete the work. This will also comprise of handling, giving credit towards salvage value and disposal of the dismantled materials with all leads and lifts or as otherwise specified.

Clause 2.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

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

The Contract unit rate for providing and compacting backfill material behind abutments and retaining walls shall be payment in full for carrying

out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

Clause 5.4.6 shall apply as regards Contract unit rate for construction of embankment under water.

Clause 5.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

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

**Measurement shall be taken and paid in Cu.m.**

**E.E.**

**Item No 40:- Construction of Granular sub base by providing 100mm thick GSB Gr- II coarse graded material using B.T. metal 26.5mm to 9.5mm @ 35%, 9.5mm to 4.75mm 25% and below 2.36mm 40% in uniform layer with motor grader on prepared surface mixing by mix in place method with vibratory roller to achieve the desired density complete as per close 401 .**

**GRANULAR SUB-BASE – as per MORT&H Section 401 for G.S.B.**

**1.1 Scope:-**

This work shall consist of laying and compacting well-graded material on prepared sub grade 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.

**1.2 Materials:-**

1.2.1 The material to be used for the work shall be (CBR minimum 30%) crushed stone, B.T. Metal size 12-75mm from approved quarry combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and conform to the grading given in Table-1.

**1.2.2 Physical Requirements: -**

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

**TABLE – 2**

**GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS**

IS : Sieve Designation	303 Percent by weight passing the IS Sieve		
	Grading-I	Grading-II	Grading-III
75.00mm	100	--	--
53.00mm		100	
26.50mm	55-75	50-80	100

9.50mm 4.75mm 2.36mm 0.425mm 0.075mm CBR Value (Minimum)	10-30     10-30	15-35     15-35	25-45     25-45
	<10 30	<10 25	<10 20

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

### **1.3 Strength of Sub base :-**

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

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

### **1.4 Construction Operations:**

#### **1.4.1 Preparation of Sub grade: -**

Immediately prior to the laying of sub-base, the sub grade already finished as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water in necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

#### **1.4.2 Spreading and compacting: -**

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

When the sub-base material consists of combination of materials mentioned as above mixing shall be done mechanically by the mix-in-place method.

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

Moisture content of the loose material shall be checked in accordance with IS : 2720 (Part-2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and a 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 percent above to 2 percent below the optimum moisture content corresponding to IS : 2720 (Part-8). While adding water, due allowance shall be made for evaporation losses, After 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 100mm a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 225mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 KN. static weight with plain drum or pad foot drum or heavy pneumatic tyre roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the center for portions having cross fall on both sides. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km. per hour.

Rolling shall be continued till the density achieved is at least 98 percent 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 those, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompacted.

### **1.5 Surface Finish and Quality Control of Work:**

The surface finish of construction shall conform to the requirements.

Control on the quality of materials and works shall be exercised by the Engineer-in-Charge.

### **1.6 Arrangements for Traffic: -**

During the period of construction, arrangement of traffic shall be maintained.

### **1.7 Measurements for Payment:**

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

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.

### **1.8 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 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 labours, 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.

### **1.9 Mode of Measurement and Payment :-**

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

The payment shall be made on Cubic meter basis without deduction of voids.

**E. E.**

**Item No. 41:- Providing & Casting in situ Controlled trimix cement concrete pavement M-350 laid as directed over a prepared sub base using cement content as per approved Design Mix manufactured in fully automatic batching plant including the cost of centring shuttering and finishing including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability. using surface hardener & other admixtures in proportion mentioned by the manufacture and laid in continuous bay as per the direction of engineer-in -charge by providing longitudinal Joints, dowel bars, tie rod including providing & laying M.S side rail of road thickness with necessary nut bolts plate and fixing as per width applying plate vibrator (electric or Diesel) on channel compressor with vacuum dewatering system by using all necessary equipment & materials such as running screed vibrator on prelaid M.S channel for levelling, Vacuum pump, floating and power travelling etc. including providing 32 mm dia. dowel bar 50 Cm. long @ 30 Cm C/C and 12mm dia Anchor bar 64CM. long at 60Cm. C/C with filling joints with bitumen as directed etc. complete.**

#### **MATERIALS :-**

Water shall conform to M-1, Cement shall conform to M-3, Sand shall conform to M-6, Grit shall conform to M-8 and coarse aggregate shall conform to M-12.

Super plastisizer shall be of approved quality.

#### **[I] WORKMANSHIP :-**

- (i) Cutting for sub-base shall be done in proper grade and camber as directed by Engineer-in-Charge. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level proper grade and camber as per instruction. Useful stuff shall be carefully stacked separately as directed. The stuff received from the cutting shall be utilized for filling cuts and correcting side slopes with all lead and lifts as directed.
- (ii) Sub-base with Crushed Metal or PCC shall be prepared as directed by Engineer-in-Charge.
- (iii) 20 CM thick M-250 grade concrete is being placed over the prepared sub-base. The relevant Specification of Item No. 5.8.2 (General Specification for building) shall be followed for M-250 mix concrete and relevant specification No. 9.1 (A) shall be followed for work required for concreting. Also the super plasticizer shall be added during mixing of concrete as recommended by manufacturer.
- (iv) Levelling of the surface is done using TRIMIX surface vibrator. The vibrator runs over channels, placed as per required level and slope and simultaneously level surface of the concrete.
- (v) Vacuum dewatering follows the levelling of concrete. The purpose of vacuum processing is to provide quicker setting and high early strength by removing surplus water from the concrete. The process is followed as per instruction of site Engineer-in- Charge & attached guide line.

(vi) Immediately after dewatering, the surface is floated with a skim power floater as per instruction of Engineer-in-Charge. The surface shall be prepared as per requirements and instructions. For smoother surface requirement, the surface is trowelled with same machine mounted with trowelling blades.

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

(viii) After surface vibrator and finishing the surface with power floater and trowel light booming on the surface, expansion joint size 20 x 115mm shall be provided with filling the expansion joint having size 20 x 20mm by using bitumen as per manufacturers specification and directed by Engineer-in-Charge.

(ix) Making a construction joints by cutting of joints of size 3mm x 20mm by using of concrete cutter machine construction joint are filled with Bitumen or an elastomeric cold applied joint sealant, which ensures performance of expected functions at the joints.

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

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

(xii) The Workmanship and process for vacuumed dewatering, water cement ratio, concrete placing, surface vibration, vacuum processing, floating, Troweling and curing shall be carried out as per specification and as per instruction of Engineer-in-Charge.

## **[II] MODE OF MEASUREMENT :**

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

(II) The rate shall be for a unit of one Cum.

**E.E.**

**Item No. 42:- Providing and fixing pre-cast concrete kerb stone of grey cement based concrete block 30cm length, 30cm height and 15cm thick of M250 grade concrete as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand) etc. complete.**

Kerb stones shall be of C.C. M-250 & best quality, as approved by the EIC and shall be obtained from reliable source. The make will be approved by the EIC. The stone shall be without any veins, cracks and flaws. The curbing stones shall be even, sound, durable and regular in shape and of uniform colour.

The size of the Kerb stone shall be as specified in the detailed drawing as approved by the EIC. The thickness of the stones shall be as specified in the manufacturer's description, with permissible tolerance of +2mm.

The stone shall have finish depending upon its use and as specified in the item or detailed drawing. The Kerb stones are to be used alongside walkways, parking, floors, docks, landscaping etc. as per requirement.

This shall include for necessary excavation. Refilling, pointing with cement mortar etc. complete for completed items of work.

### **Mode of Measurement:-**

The rate shall be for a unit of one Running meter for completed items of works.

**E. E.**

**Item No. 43:- Providing and fixing pre-cast Rubber Dye / steel Dye inter locking concrete Paver block 60mm thick with grade of concrete M300 pneumatic compressed / vibrated mechanically and as per approved design Confirming to IS 15658: 2006 including 35 mm Sand layer for levelling and filling the joint with sand in proper line and level as per guidelines of IRC: SP 63-2018 etc. Complete.**

### **1.0. Material:-**

1.1 The rubber moulded paver block shall be approved and best quality and thickness as specified in description of item.

1.2 The sand shall confirm to M-6.

### **2.0. Workmanship:-**

2.1 The work shall be carried out as per IS 1443-1972.

2.2 Before the sand bedding the ground shall be in proper line and level as directed.

2.3 The sand bedding shall be laying as per proper line and level.

2.4 After laying sand bedding should be proper watering and ramming as per instructed by Engineer-in-charge.

2.5 The sand bedding layer shall be not less than 30mm and Average thickness of bedding shall be 75mm.

2.6 The pre-cast blocks are fixed on bedding as per proper line and level.

- 2.7 The joint shall be of uniform thickness and in straight line as per pattern.
- 2.8 The colour and design of Precast block shall be as per directed by Engineer-in-Charge.
- 2.9 In places where full block cannot be fixed the block shall be cut of the size and smooth and at edges to give straight and line joints.
- 2.10 If any block is disturbed or damage it shall be refitted or replaced properly jointed.
- 2.11 The joints or edges where there is no possibility provide to fix the paver block it should be finished or locked with cement concrete of same strength.

### **3.0. Mode of Measurements & payments.**

- 3.1 Precast Inter locking paved flooring shall be measured in Sqmt. for visible area of work done.
- 3.2 The rate shall include the cost of all materials, labour involved in all the operations as described above.
- 3.3 The rate shall be for a Unit of one Sqmt.

**E.E.**

**Item: 44 :- Providing and applying two coats of coal tar or bitumen confirming to IS:3117 - latest version on the top and sides of RCC box/slabs @ 1.70 kg/sqm after cleaning the surface with all labour and materials complete job as directed by the engineer.**

1.0 The Contractor shall arrange bitumen as per IS:3117 for apply on the foundation, pier, abutment to avoid penetration of moisture in concrete work.

2.0 Contractor have to demonstrate the sample on the surface, approve the methodology and got approve the sample. Only trained and experience worker shall execute the work.

Curing work for the structure must be completed for 28 days and surface must be let for dry for min 7 days.

3.0 All joints must be levelled, no honey combing, porous on concrete surface. Surface must be complete dry, no moisture visible on surface. Brush the dry concrete surface, remove all grit, dust, grease and apply hot bitumen on the surface @ 1.70kg/sq, evenly and uniformly. Bitumen temperature shall not be more than 120 Degree. It is preferably to execute this work 10am to 5 pm when concrete structure surface have no moisture and concrete is not too cold.

4.0 Next day, apply 2<sup>nd</sup> coat of bitumen @ 1.70kg/sq.m. Where Filter media have to place as per approved drawing, care shall be taken that boulder shall not throw on the treated surface, just place manually to avoid damage to the treated surface.

**E.E.**

**Item No. 45:- Finishing Wall with Weather Proof Exterior Emulsion Paint on Wall Surface (Two Coats) to give a required and even shade after thoroughly brushing the surface to remove all dirt, and remains of loose powdered materials etc. complete**

### **1.0 Materials**

1.1 The water shall conform to M-1. Weather Proof Exterior Emulsion Paint shall conform to I.S.I.

### **2.0 Workmanship**

2.1 Scaffolding : Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders are used pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

2.2 Preparation of surface : The undecorated surface to be distempered shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry for at least 2 months before applications of distemper.

2.3 All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster again with a fine grade sand paper and made smooth. A coat of Weather Proof Exterior Emulsion Paint shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is allowed. The surface affected by moulds, moss, fungi, algae lichens, efflorescence etc. shall be treated in accordance with I.S; 2395 (Part 01) 1966. Before applying Weather Proof Exterior Emulsion Paint, any unevenness shall be made good by applying putty made of plaster of pairs mixed with water on entire surface including filling up the undulation and then sand papering the same after it is dry.

### **3.0 Priming coat :**

3.1 A priming coat of distemper primer of approved manufacture and shade shall be applied over the papered surface in case of new work on undecorated surface. If the Weather Proof Exterior Emulsion priming is done after the wall surface dries completely, the Weather Proof Exterior Emulsion Paint primer shall be applied. Application of primer shall be done as under: The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute on coat. The surface shall be finished as uniformly as possible



leaving no brush marks. It shall be allowed to dry for at least 48 hours before Weather Proof Exterior Emulsion Paint is applied.

3.2 Weather Proof Exterior Emulsion Paint is not recommended to be applied within six months of the completion of wallplaster.

3.3 Preparation of paint: Weather Proof Exterior Emulsion Paint shall be prepared by adding water and stirring, which shall then be diluted to a brush able consistency. Generally, equal volumes of Weather Proof Exterior Emulsion Paint and water make a satisfactory paint. In all cases. The manufacturer's instructions shall Site followed. The paint shall be mixed in such quantities as can used up within an hour of mixing as otherwise the mixture will set and thickness, affecting flowing and finish. The lids of cement paint drums shall be kept tightly when not in use.

#### **4.0 Application of Paint:**

4.1 No painting shall be done when the paint is-likely to be exposed to a temperature of below 7<sup>0</sup> c within 48 hours after application.

4.2 When weather conditions are such as to cause be carried out in the shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

4.3 To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.

4.4 For undecorated surfaces, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two coats. Next coat shall not be started until the proceeding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather, the proceeding coat shall be slightly moistened before applying the subsequent coat.

4.5 The finished surface shall be even and uniform in shade, without patches, brush masks, paint drops etc.

4.6 The Weather Proof Exterior Emulsion Paint shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lamps shall be brushed out.

4.7 Weather Proof Exterior Emulsion Paint shall not be applied on surface already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

4.8 Curing : Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the point has hardened so as not be damaged by the sprinkling of water say about 12 hours after the application.

#### **5.0 Mode of measurements and payment**

5.1 All the work shall be measured in the decimal system as under:

5.2 Dimensions shall be measured to the nearest 0.01 m.

5.3 Area in individual item shall be worked out to the nearest 0.01 sq.m.

5.4 All the work shall be measured in sq. mt. Deductions for jambs, soffits, sills etc. for openings not exceeding 0.5 sq. mt. each in area, for ends of joists, posts, beams, girders, steps etc. not exceeding 0.5 sq.mt. each in area and for openings exceeding 0.5 sq. mt. and not exceeding 3.0. sq. mt. each in area, deductions and additions shall be made as under.

5.5 No deductions shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.5 sq.mt. each. No addition shall be made for reveals, jambs, soffits, sills etc. of these openings not for finish around ends of joints, beams, posts etc.

5.6 No deductions for openings exceeding 0.5 sq.mt. but not exceeding 3 sq. mt. each shall be made as follows and no addition will be made for reveals, jambs, soffits etc. of these openings :

5.7 When both the faces of walls are provided with finish, deduction shall be made for one face only.

5.8 When each face of wall is provided with different finish, deduction shall be made for that side of frame for door, windows, etc. on which width of reveals is less than that of the other side. Where width of reveals on both faces of wall are equal, deduction of .50% of area of opening on each face shall be made from total area of finish.

5.9 When only one face of wall is treated and the other face is not treated, full deduction shall be made if the width of reveal on the treated side is less than that on the untreated side, but if the width of the reveal is equal or more than on the untreated side neither deductions nor additions to be made for reveals, jambs, soffits, sills etc.

5.10 In case of area of openings exceeding 3 sq. mt. each, deductions shall be made for openings but jambs,soffits, sills shall be measured.

5.11 No deductions shall be made for attachment such as casing, conducts, pipe, electric wiring and the like.

5.12 Corrugated surfaces shall be measured flat as fixed and not girth. The quantities so measured shall be increased by the following percentage and the resultant shall be included with the general areas:

Corrugated steel sheets 14%

Corrugated A.C. sheets 20%

Semi corrugated A.C. Sheets 10%

Naintial pattern roof (Plain sheeting sheets) 10%

Naintial pattern roof (with corrugated sheets) 25%

Cornices and other wall features, when they are not picked out in a different finish/colour shall be girthed and included in the general area.

5.13 The rate shall include the cost of all materials, labour, scaffolding, protective measures etc. involved in all the operations described above.

5.14 The rate shall be for a unit of One sq. meter.

**E. E.**

**Item No. 46:- Painting lines, dashes, arrows, letters etc on roads, Air fields and like in two coats with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter. Over 10cm in width.**

**1.0. Materials**

1.1. The road marking paint shall conform to. I.S. 164-1951.

**2.0. Workmanship**

2.1. The relevant specifications the letters and figures 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, item No. 19.119(1) shall be followed except that the painting lines, dashes, arrows and letters on roads, air fields and like shall be carried out with road marking paint in two coats : over 10 cms. in width.

**3.0. Mode of measurements and payment**

3.1. Letters, figures and similar items etc. stops, commas, hyphens and the like shall be deemed to be included.

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

3.3. The rate shall be for a unit of one sq. meter.

**E.E.**

**Item No 47:- Road marking with hot applied thermoplastic paints with reflectorizing glass beads on bitumen surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorizing glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/centre line/ edge line/cut patta. The white colour marking should provide luminance coefficient on cement road shall be min 130 mcd/m<sup>2</sup>/lux and Asphalt road shall be min 100 mcd/m<sup>2</sup>/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.**

**1. General:**

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

(ii) The thermoplastic compound shall be screened /extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

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

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

**2. Thermoplastic Material**

**2.2. General:** The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflector sing beads.

### 2.3. Requirements

**(1) Composition:** The pigment, beads, and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-3.

TABLE 900-3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL		
(Percentage by weight)		
Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30-40	30-40
Titanium Dioxide	10.0 Min.	-----
Calcium Carbonate and		
Inert Fillers	42.0 Max.	See
Yellow Pigments	-----	Note

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

**(II) Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262- (Paint 1), shall be as below:

#### (a) Luminance:

**White:** Daylight luminance at 45 degrees-65 per cent min. as per AASHTO M 249

**Yellow:** Daylight luminance it 45 degien-45 per cent min. as per AASHTO M 249

**(b) Drying time:** When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to been traffic in not mom than 15 minutes.

**(c) Skid resistance:** not less than 45 as per BS 6044.

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

**(e) Softening point:**  $102.5 \pm 9.50$  C as per AASTM D 36.

**(f) Flow resistance:** Not more than 25 per cent as per AASHTO M-249.

**(g) Yellowness Index (for white thermoplastic paint):** not more than 0.12 as per AASHTO M 249

**(III) Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or un melted particles for the one year storage period. Any material not meeting the above requirements "I am replaced by the manufacturer/ supplier/Contractor.

**(iv) Reflectorisation:** Shall be achieved by incorporation of beads. the grading and other properties of the bonds shall be as specified in Clause 803.4.3.

**(v) Marking:** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1. The name, trade mark or other means of identification of manufacturer, 2. Batch number, 3. Date of manufacture, 4. Color (white or yellow) & 5. Maximum application temperature and maximum safe beating temperature.

**(vi) Sampling and testing:** The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

### 4.3. Reflectorizing glass beads

**4. 3.1. General:** This Specification covers two types of glass beads to be used for the production of reflectorized pavement markings.

**Type I** beads -are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

**4.3.2.** The glass beads shall be transparent, colour less and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 803.4.3.3.

#### 4.3.3. Specific requirements

**A. Gradation:** The glass beads shall meet the gradation requirements for the two types as given in Table 800-4.

**TABLE 800-4 GRADATION REQUIREMENTS FOR GLASS BEAD**

Sieve size	Per cent retained	
	Type 1	Type 2
1.18 mm	0 to 3	-----
850 micron	5 to 20	0 to 5
600 -do-	----	5 to 20
425 -do-	65 to 95	-----
300 -do-	-----	30 to 75
180 -do-	0 to 10	10 to 30
below 180 micron	-----	0 to 15

**B. Roundness:** The glass beads shall have a minimum of 70 per cent true spheres.

**C. Reflective index:** The glass beads shall have a minimum reflective index of 1.50.

**D. Free flowing properties:** The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

**4.3.4. Test methods:** The specific requirements shall be tested with the following methods:

(i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccator's plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100mm stem and 6 mm orifices, if necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.

(ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).

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

#### 4.4. Application properties of thermoplastic material

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

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

#### 4.5. Preparation:

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

(ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

#### 4.6. Properties of finished road marking

(a) The stripe shall not be slippery when wet.

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

- (c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 degree centigrade.
- (d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- (e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- (f) The color of yellow marking shall conform to IS Color No. 356 as given in IS: 164.

#### **5. Reflectorized Paint**

Reflectorized paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorizing glass beads for reflectorizing paints where used shall conform to the requirement of Clause.

#### **6. Application**

**6.1.** Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

**6.2.** The thermoplastic material shall be applied DRUM either by screening or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

**6.3.** The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt grease, oil and all other foreign matter before application of the paint. The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the DRUM paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

**6.4.** The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS - 3262 (Part 3).

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

#### **7. Measurements for Payment**

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

#### **8. Rate**

The Contract unit rate for road markings shall be payment in full compensation for furnishing a labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work to these Specifications.

**E. E.**



**Item No 48:- Cat Eye / Road Stud / RPM: Supplying of Molded Twin Shanks mould body and reflective panels with micro prismatic lens capable of providing total internal reflection of light entering the lens face and shall support a load of 13635kgs tested in accordance to ATM D 4280 type H and complying to specification of category A of Morth circular No.RW/NH/33023/10-97 DO III dt. 11-06-1997. The length,width and height shall not exceed 20mm,130mm and 130mm and with minimum reflective area of 13sqcm on each side and the slope to the base shall be 35+/-5 degree.The strength of detachment of the intergrated cyclindrical shank (of the diameter not less than 19+-2mm and height shall not less than 30+-2mm from the body is to be a miniumum value of 500khf. Fixing will be by drilling holes on the road for the shanks to go inside without nail and using epoxy resin based adhesive as per manufacturers recommendation and the colour of the marker should be as per the IRC-35-2015 and as directed by the Engineer in charge.**

OA	EA	LUM INTENSITY MCD / LUX		SPECIFIC INTENSITY CD / FTC			
		W	Y	R	W	Y	R
02	0	558	334	140	60	36	65
02	20	223	134	56	24	14	06

Compressive Strength 13 Tones at 23° C Temp. Single side lens.

### 1.0 GENERAL :

Reflective pavement MARKER (IRPM) of road stud is a device which is bonded to or anchored within the road surface for lane marking and Delineation for night time visibility. It reflects incident. Light in directions close to the I direction from which it came.

### 2.00 Definitions:

2.01 Description of items specific to this standard:

2.1.1 Coefficient of luminous intensity (CAL) of specific intensity the ratio of luminous intensity of the retro reflector in the direction of observation to luminance at the retro reflector on a plane-perpendicular to the direction of the Incident light, expressed in terms of millicandelas per incident lux (MCD/IX)

2.1.2 Horizontal entrance angle

The angle in the horizontal plane between the direction of incident light and normal to the leading edge of the marker.

2.1.3 Observation Angle

The angle at the reflector between the illumination axis, and the observation axis.

2.1.4 Retro Reflection

Reflection in which the radiation is returned in direction close to the directions from which it came, this property being maintained over wide variations of the direction of Incidental radiation.

2.1.5 Head

That part of a road stud which is above the road surface when the road stud is fixed in position in the road.

2.1.6 Upper surfaces that part of the external surface of road stud which is visible when the road mud is fixed in position in the road.

2.1.7 Anchorage that part of a road stud which is below the mad surface when the road stud is fixed in position in the road.

### 3.0 MATERIAL

3.1 Plastic body or RPM/road stud shall be molded from ASA (Acrylic Strene Acryl nitrite) or HIPS (Hi-impact polystyrene) or ABS or any other suitable material approved by the Engineer-in-Charge. The marker shall support a load of 13635 Kg. Tested in accordance with ASTM-D-4280

3.2 Reflective panels shall consist of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face Lenses shall be molded or methyl methacrylate conforming to ASTM-D-788 or equivalent

### 4.00 DESIGN

4.1 The slope of retro reflecting surface preferably be  $35 \pm 5$  degree to base

4.2 The area of each retro-reflecting surface shall not be less than 13.0 Sq. cm.

### 5.0 Optical Performance

5.1 Unidirectional and bi-directional studs.

5.1.1 Each reflector of combination of reflectors on each of the stud shall have a C.I.L. not less than that given in Table-1 below.

**T A B L E : - Minimum C.I.L Values for Category – A Studs.**

Entrance Angle	Observation Angle	C.I.L. In Med / IX		
		White	Amber	Red
0° U 5° L & R	0.3°	220	110	44
0° U 10° L & R	0.5°	120	60	24

## **1.2 Tests :**

5.2.1 Coefficient of luminance intensity can be measured by procedure described in ASTM-E-809 " Practice for measuring Photometric- Characteristics" or as recommended in BS 873 part 4: 1973.

5.2.2 Under, test conditions, a stud shall not be considered to fail the photometric requirements If the measured C.I.L, at any one position, If measurement is less than the values specified in Table 1 or 2 provided that.

(I) The valve is not less than 80% of the specified minimum and

(II) The average I of the left and right measurements for the specific angle is greater than the specified minimum.

## **6.0 FIXING OF REFLECTIVE MARKERS:**

### **6.1 Requirements**

6.1.1 The enveloping profile or the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic

6.1.2 The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate.

6.1.3 All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

6.1.4 Marker height shall not exceed 20mm.

6.1.5 Marker width shall not exceed 130mm.

6.1.6 The base of the marker shall be flat within 1.3mm if the bottom of the marker is conflagrated. The outer most face of the configurations shall not deviate more than 1.3mm from a flat surface.

### **6.2 PLACEMENT**

6.2.1 The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

6.2.2 Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 days.

6.2.3 The portions of the highway Surface, to which the marker is to be bonded by the adhesive shall be free of dirt, curing compound grease, oil, moisture, loose or unsound layers paint and any other material which would adversely affect the bond of the adhesive.

6.2.4 Use a wire brush if necessary to loosen in remove dirt, then brush or blow clean.

6.2.5 The adhesive shall be placed uniformly on the cleaned pavement Surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of marker with no voids present and with a slight excess after the marker has been lightly pressed in place.

6.2.6 For epoxy installations excess adhesive around the edge of the marker, excess adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used, If necessary to remove adhesive exposed faces of pavement markers.

## **7.00 WARRANTY AND DURABILITY**

The Contractor shall obtain from the manufacture a two year warranty for satisfactory field performance including stipulated retro reflectance of the reflective panel and submit the same to the Engineer-in-Charge. In addition a two year warranty for, satisfactory infield performance of the finished road, marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case markers are displaced damaged get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the Intimation from the Engineer and of his own cost and with no extra remuneration to be paid for such work.

## **8.0 MEASUREMENT FOR PAYMENT**

The measurement of reflective road markers shall be in numbers of different types of markers supplied and fixed.

## **9.0 RATE**

The Contract unit rate for reflective road markers shall be payment in full compensation for furnishing all labour, material, tools, equipment including all incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawing or, as directed by the Engineer.

**Signature of Contractor**

**Executive Engineer**  
**Devbhoomi Dwarka R & B Division**  
**Khambhaliya**

**Item No.2:- Collection, Loading, Transportation, leading, lifting, unloading, dumping all unusable material to nominated dumping yard and levelling all heaps with ramp for movement of dumpers, tractors trolley.**

**1.0 Workmanship**

The Agency should clean site premises at Khamnath Bridge on Khambhaliya Porbandar road including labour and material. The machineries as required is to be brought by contractor at his own cost. The debris collected through machine or labour should be kept in a place and transfer it to outside of municipal limit. Any other work shall have to be perform as instructed by Engineer-in-charge.

**1.0 Mode of measurement and payments:**

The payment shall be made on Cum. Basis for completion of the items including all man power and machineries as per direction of the Engineer-in-charge to the satisfaction of completion of the items.

**E. E.**

**Item: 43 :- Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30cm length,30cm height and 15cm thick of M250 grade concrete as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand) etc complete.**

Kerb stones shall be of C.C. M-250 & best quality, as approved by the EIC and shall be obtained from reliable source. The make will be approved by the EIC. The stone shall be without any veins, cracks and flaws. The kerbing stones shall be even, sound, durable and regular in shape and of uniform colour.

The size of the Kerb stone shall be as specified in the detailed drawing as approved by the EIC. The thickness of the stones shall be as specified in the manufacturer's description, with permissible tolerance of +2mm.

The stone shall have finish depending upon its use and as specified in the item or detailed drawing. The Kerb stones are to be used alongside walkways, parking, floors, docks, landscaping etc. as per requirement. This shall include for necessary excavation. Refiling, pointing with cement mortar etc. complete for completed items of work.

MORT&H specifications as in section 1500 (P.No. -519), 1700(P.No. -535)

,2300(Pg. No-675) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS a specification are also applicable.

The measurement shall be in Sqm basis of complete item done.

**E.E.**

**Item No. 53:- Providing and fixing pre-cast concrete kerb stone of grey cement based concrete block 30cm length,30cm height and 15cm thick of M200 grade concrete as**

**per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand) etc. complete.**

Kerb stones shall be of C.C. M-200 & best quality, as approved by the EIC and shall be obtained from reliable source. The make will be approved by the EIC. The stone shall be without any veins, cracks and flaws. The curbing stones shall be even, sound, durable and regular in shape and of uniform colour.

The size of the Kerb stone shall be as specified in the detailed drawing as approved by the EIC. The thickness of the stones shall be as specified in the manufacturer's description, with permissible tolerance of +2mm.

The stone shall have finish depending upon its use and as specified in the item or detailed drawing. The Kerb stones are to be used alongside walkways, parking, floors, docks, landscaping etc. as per requirement.

This shall include for necessary excavation. Refiling, pointing with cement mortar etc. complete for completed items of work.

Mode of Measurement:-

The rate shall be for a unit of one Running meter for completed items of works.

## **E. E.**

**Labour charges for dry stone pitching of 20.0 cm. thick including preparing the surface etc. as complete job.**

1. The work shall consist of Labour Work including all Tools, Tackles & Equipment for covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.
2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.
3. Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and uniform slope throughout. Depressions shall be filled and thoroughly compacted.
4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 mm. Quality of murrum will be as per its relevant specifications.
5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panels of 3.0 M x 3.0 M with a 30 CM wide and 8 Cm. deeper band all around.
6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.
7. The rate shall include the cost of preparing the base, putting to the profiles, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour as well as tools and plant required of the work.

E. E.