

STANDARD TECHNICAL SPECIFICATIONS FOR BRIDGE REPAIR ITEMS

The specifications in general for this contract are as per MORT&H fifth revision. However, for ready reference item wise specifications based on MORT&H are given. In case of any ambiguity or discrepancy, MORT&H specification shall govern.

Item No. 1

Diversion of water course, providing cofferdam and bund or island as may be necessary for foundation and maintaining the same for the period as may be necessary. (F) Abutment Left (including returns/ wing walls)

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

Item no. 2

Providing flood gauge marks on substructure as per design including painting complete.

1. The width of flood gauge shall be 60 cm and shall have cannerly yellow background color. The flood gauge marking shall be in 10 cm thick strips of alternative black and white color. The width of strip shall be as under.
 - (a) At every 10 cm - 15 cm width
 - (b) At every ½ cm - 25 cm width in black
 - (c) At every meter - 35 cm width in white.

The lettering shall be black in color and of 10 cm height. The lettering shall show every meter and ½ m level. The lettering shall show based on either GST Benchmark or Arbitrary Benchmark as furnished by engineer in charge.
 2. All painting work shall be done in 3 coats. The paint shall be of approved make. Painting work shall be applied after thoroughly brushing the surface to remove all dirt & loose powdered material shall be carried out as per direction of Engineer-in-charge.
 3. The measurement will be in **square meter**.
 4. The rate includes all materials, labor, equipment, plant, transportation etc. to execute this item.
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Item no. 3

Providing masonry steps with Cement Pointing on approaches as directed.

- The work shall consist of construction of steps with bricks joined together by cement mortar, in accordance with the details shown on the drawings or as approved by the engineer.
- All the materials to be used in the work shall conform to the requirements laid down in section 1000 of MORTH
- Construction of brick work shall be carried out only by masons having sufficient experience /training in the work.
- Cement and sand shall be mixed in the specified proportions given in the drawings.
- All brickwork shall be laid true to line, plumb and level and all joints accurately kept in accordance with the drawing or as directed by the engineer in-charge.
- Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of 7 days.
- All tools and equipment used for mixing, transporting and laying of mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.
- Cement pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown in the drawing.
- The Rate shall be paid **according to the steps.**

Item no. 4

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

Scope:

1. MORT&H specification -201(Pg. No-37) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
2. All excavations below the general ground level arising out of the removal of trees, stump etc. shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.
3. All materials arising from clearing and grubbing operations shall be the property of the Government and shall be disposed of by the Contractor as directed by the Engineer.
4. The rate on Hectare basis shall include all necessary equipment, materials required in completing the job as required, as per direction of Engineer-in-charge.
5. After completion of work the contractor has to reinstate and level the ground to its original ground & original position and contractor also has to remove oil, derrises, dismantled materials, staging pedestal/Foundation from the site or instruction of engineer-in-charge.
6. The Rate shall be paid per Hectare.

**Item No. 5: Excavation for foundation in sand, gravel, clay soft soils and murrum etc. including shoring, Strutting dewatering as necessary and disposing of the excavated stuff as directed.(A)
Depth upto 3.0 M. and lead upto 100m for 10 Cum**

1. Excavation for structures shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, head walls, 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, shorting, bracing, draining and pumping and the removal of all logs, stumps, scrubs 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 materials.
- 2 After the site has been cleared the limits of excavations shall be set out true to lines, curves, slopes and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar-concrete etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as the opinion of the Engineer-in-charge, they are required for the work.
- 3 Excavation shall be taken to the width of the 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 materials 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, rain or other reasons, the contractor shall take adequate measure 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 method 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 Back filling 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 materials are to be used in the construction of embankment, it shall be directly deposited at the required location within 100 meters lead.
- 11 All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 100 meters lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
- 12 Excavation for structures shall be measured in Cubic Meter 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 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. Settings 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. Foundation sealing, including necessary dewatering including pumping and making necessary cofferdam to facilitated construction work.
6. Back filling, clearing up the site and disposal of all surplus materials with in all lifts and lead up to 100 meters.

All labour, materials, tools, equipment, safe guards and incidentals, necessary to complete the work to the specification.

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

Payment shall be made on **Cu.m.** basis.

Item No. 6: 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.

Excavation for structures shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, head walls, 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, shorting, bracing, draining and pumping and the removal of all logs, stumps, scrubs 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 materials.

1. After the site has been cleared the limits of excavations shall be set out true to lines, curves, slopes and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar-concrete etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as the opinion of the Engineer-in-charge, they are required for the work.
2. Excavation shall be taken to the width of the 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.
3. The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of materials encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
4. Where water is met with in excavation due to stream flow, seepage, rain or other reasons, the contractor shall take adequate measure 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 method 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.

5. 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.
6. 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.
7. 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.
8. Back filling 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.
9. All the excavated materials shall be the property of the Government. Where the excavated materials are to be used in the construction of embankment, it shall be directly deposited at the required location within 100 meters lead.
10. 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.
11. Excavation for structures shall be measured in Cubic Meter 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 be measured and paid for separately.

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

- Settings out and fixing bench marks and center lines stones.
- Construction of necessary shoring and bracing and their subsequent removal.
- Removal of all logs, stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations.
- Foundation sealing, dewatering including pumping.
- Foundation sealing, including necessary dewatering including pumping and making necessary cofferdam to facilitated construction work.
- Back filling, clearing up the site and disposal of all surplus materials with in all lifts and lead up to 100 meters.

All labour, materials, tools, equipment, safe guards and incidentals, necessary to complete the work to the specification.

13. Excavation shall be in hard soil such as stiff heavy clay, hard shale or compact murrum required 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.

14. Payment shall be made on **Cu.m.** basis.

Item No. 7: Excavation in large boulders and soft rock by welding including shoring, strutting and dewatering as necessary and disposing of the excavated stuff as directed.

Para 1 to 13 of the **Item No. 5** of excavation for foundation in sand.....shall apply.

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 required 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 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.
15. Payment shall be made on Cu.m. basis.

Item No. 8: 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. (B) prohibited Blasting. work.

1. Para 1 to 13 of the **Item No. 5** of excavation for foundation in all sorts of soil shall apply.

14. Excavation shall be in any rock or boulders for which the use of mechanical plant for blasting is required. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-charge.

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

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

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

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

(a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.

(b) A statement of up to date stock in the magazine.

(c) A certificate showing the last date of testing of the lightning conductor,

(d) A notice that smoking is strictly prohibited.

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

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

21. The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.
22. The blasting shall be carried out during fixed hours of the day preferably during the midday lunch hour or at the close of the works as ordered in writing by the Engineer-in-charge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.
23. Red danger flags shall be displayed prominently in all directions during the blasting operations people except those who actually light the fuse shall be prohibited from entering this area. The flags shall be planted 200 metres from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.
24. The charge holes shall be drilled to required depths and in suitable places. Blasting should be as light as possible consistent with through breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.
25. When blasting is done with powder the fuse cut to the required length shall be inserted into the hole and powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then, be covered with tamping materials which shall be tamped light but firmly.
26. When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end the detonator gently pushed into the primer leaving 1/3rd copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire, or twine. The primer shall be housed into explosive. Bore holes shall be of such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive inserted. The space of about 20 cm. above the charge shall then be gently filled with dry clay, passed home and the rest of the tamping formed of any convenient material gently packed with a wooden rammer.
27. At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charge shall be lighted by the man in charge only. The man in charge shall count the 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 charge.
- (2) If is the blasting powder charge R shall be completely flooded with water. A new hole shall be drilled at about 45 cm. from the old hole and fired. This should blast the old charge. Should it not blast the old charge, the procedure shall be repeated till the old charge is blasted.
- (3) In case of charges of 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. After natively the hole may be cleared of 30 cm. of tamping and the direction then as ascertained by placing a stick in the hole. Another hole may then be drilled 15 cm. away and parallel to it. This hole shall then be charged and fired, the misfired hole should explode at the same time. The man in charge shall at once report to the Contractor's office and Engineer-in-charge all cases of misfire, the cause of the same and what steps were taken in connection there with.

29. If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer-in-charge for inspection to ascertain whether all the remaining materials in the box are also defective.
30. A careful and day to day account of the explosives shall be maintained by the Contractor in the approved register and manner which shall be open to inspection by the Engineer-in-charge at all times.
31. Excavation shall be measured after removal of over burden by taking cross-sections at suitable intervals in the original position before the work starts and after its completion, and computing the volumes in cubic metres by the method of average end areas. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods. At the option of the Engineer-in-charge, the contractor shall leave depth indicators during excavation of such shape and size, and in such positions as directed so as to indicate the original ground level as accurately as possible. The Contractor shall see that these remain in fact till the final measurements are taken. Where cross sectional measurements could not be taken due to irregular configuration, or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 40 percent deduction there from.
32. Payment shall be made on **Cu.m.** basis.
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Item no. 9

Providing and laying boulders apron on riverbed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification.

A) Boulder laid dry without wire crates.

- The work shall consist of laying boulders directly on the bed of rivers for protection of scour.
- The stones used in aprons shall be sound, hard, durable and fairly regular in shape. Stones subject to marked deterioration by water or weather shall not be used.
- Quarry stones having angular shapes shall be preferred to round boulders.
- The size of stone shall conform to clause 5.3.7.2 of IRC-89
- The size of stone shall be as large as possible, and no stone shall weigh less than 40 kg. The specific gravity of stones shall be as high as possible and not less than 2.4
- To ensure regular and orderly disposition of full intended quantity stone in the apron, template across walls in dry masonry shall be built about a meter thick and to the full height of the specified thickness of the apron at intervals 30m all along the length and width of the apron. Within these walls, the stone shall be hand packed.
- The surface on which the apron is to be laid shall be levelled and prepared for the length and width as shown on the drawings. In case the surface is below the low water level, the ground level may be raised up to low water level by dumping earth and the apron laid thereon. In such cases, the quantity of stone required in an apron shall be re-worked by taking the toe of pitching at a higher level.
- The Rate shall be paid per **cubic meter**.

Item no.10

Providing and filling in foundation with ordinary Cement concrete M-150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

1. **MORT&H specifications as in section 1000**(Pg. No-439), **1500**(Pg. No-519) & **1700**(Pg. No-535) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
2. **The payment measurement shall be in cubic meter of concrete.**
3. The rate tamping, Vibrating, levelling dewatering, shuttering, mixing in mechanized batch mix plant, compacting, curing etc. complete true to level and position as directed by Engineer and as per specification.

Item no. 11 to 13

- Providing and casting in situ-controlled cement concrete M-300 for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (B) Height from 0.0 to 5.0 M. (1) Piers (2) Abutment (3) RCC return
- Providing and casting in situ-controlled cement concrete M-300 for RCC. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (B) Height from 5.0 to 10.0 M. (1) Piers (2) Abutment (3) RCC return
- Providing and casting in situ-controlled cement concrete M-300 for RCC. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (B) Height from 10.0 to 15.0 M. (1) Piers (2) Abutment (3) RCC return

1. **MORT&H specifications as in section 1000** (Pg. No-439), **1500** (Pg. No-519), **1700** (Pg.No-535, **2200** (Pg. No-669) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
2. Relevant specifications of plain and reinforced cement concrete shall apply to this item.
3. **The measurement shall be on cubic meter of concrete done.**
4. The rate includes all materials, labor, plants and everything required to execute this item.

Note.: Herein M-350, “350” Indicates characteristics strength of concrete at 28 days = 350kg/cm² (M35 = 35 n/mm²)

Methodology for jacketing of substructure

1. Excavate the area around base of substructure (abutment / pier / return) of size shown in drawing or as per instruction of Engineer in-charge. **(As per relevant item)**
2. Chip off concrete cover or Deteriorated concrete from substructure (abutment / pier / return) surface using chisel and hammer for area to be jacketed. Electrically operated chisel (Light duty Mechanical breaker / hammer) may be used. Debris should also be cleared on a regular basis and area to be kept clean. The loose concrete behind reinforcement, if any should be carefully removed. Only loose concrete should be taken out. This can be checked by lightly sounding the hammer over chipped area to ascertain any hollow sound on substrate. **(As per relevant item)**
3. Removal of corrosion scales on corroded reinforcement bars should be done manually using sharp tools such as chisel to scrape rust scales from the surface. Thereafter, use wire brushes to clean the surface of the rebar. Since the brush would not be able to access behind the bars use emery paper to clean exposed surface as well as areas with difficult access. Rotary wire brushes, shaft type rotary wire brushes can be used in place of hand-held brushes. Exposed concrete surface is also to be cleaned with wire brush/rotary wirebrush to remove all the loose material, dust, dirt oil etc.
4. Finally clean the exposed area with high pressure water jet of suitable pressure and allow the surface to get dry.
5. All exposed old reinforcement shall be cleaned using rust remover **Reebaklens RR of Fosroc make or Rust clean of BASF or equivalent** and then washed with clean water to remove traces of rust remover and finally allowed to dry. **(As per relevant item)**

6. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply Two component epoxy-based zinc rich anti-corrosive primer Nitozinc Primer or equivalent material of BASF with the help of brush such that continuous film is formed on rebar and no rebar is left uncoated.
7. Drill holes of 14 mm/16 mm/20 mm (Dia. of Anchor + 4 mm) at spacing of 500 mm C/C in staggered manner. And clean the holes with air pressure.
8. Provide 10 mm/12 mm/16 mm shear anchors in drilled holes with an anchor grout. Provide new reinforcement of 8/10/12/16/20 mm dia. At suitable spacing both ways. **(As per relevant item)**
9. Apply bonding agent on exposed surface for proper bonding between old surface and new surface. **(As per relevant item)**
10. Provide watertight formwork for concreting and pour Concrete of M350 (M35) Grade for jacketing.
11. After removal of Formwork, concrete shall be cured as per the instruction of engineer in-charge.

Item no. 14

Scaffolding: - Providing, erecting and dismantling safe H frame and / pipe scaffolding including working platform for external area of bridge pier to facilitate all works etc. completed, Measurement for payment shall be considered as per detailed specification. (Property of contractor, and repetitions will be paid per pier) (for Every 1 m extra height, increase the rate by 50 rupees/ meter height)

A) up to 5.0 mt

Purpose:

Providing, erecting, removing and taking away proper & safe working platform and scaffolding for working in all part of Bridge area as required.

Material:

- a) Cup-lock scaffolding or steel H frame or Pipe Scaffolding: - Min 40NB Medium class Pipe.
- b) Metal Jacks for Supporting.
- c) GI Corrugated Sheet & Safety net 75 x 75 x 12mm
- d) Drill and drill bit & Anchors as required.

Methodology:

- a) Working platform should be erected with sturdy Plywood tied to pipe grid, which were connected to Pipes hanging from the Beam/ soffit of the slab with the help of Chemical Anchor fixed with base plate and pipes are welded / connected to plate and hanged thereupon.
- b) Access platform should be approved by submitting proposed drawings with the EIC.
- c) Proper arrangement in form of Safety net and / or corrugated GI sheet to be placed, All the loads coming on slab/wall/pier which are found to be heavily distressed should be transferred to temporary supports system by means of supported using Metal Jacks, props with wooden chaavi till the same is rehabilitated.
- The scaffolding to areas such as Pier, retaining walls, slab soffit etc. shall be done in Double layer scaffolding. The elevation type scaffolding if done in Steel pipes, couplers and/ or H- frames then the min. dia. of pipe should be of 40 NB medium Class. Spacing shall be kept max. 1.8 Mt. c/c between verticals and 1.2 mt. c/c between horizontals. The distance between two adjacent planes in elevations shall be up to 1.2 Mt. c/c.
- When access of varying height is to be provided to a large plan area (such as slab soffits more than 4 mtr. high) then scaffolding when provided in Steel pipes, couplers and or H frames then the verticals are to be at 1.8 mtr c/c and horizontals in both directions to be at 1.2mtr c/c. In case of H frames, the Verticals in braced direction to be 2.4 mtr c/c max (distance between two H frames braced by two diagonal bracings on either side)
- The rate includes all work required to be done for this item including the cost of all materials, labor, equipment etc. as directed.
- **The measurement for payment shall be in square meter basis of the finished work.**

Item no. 15

Portable Barricade in Construction Zone (Installation of a steel portable barricade with horizontal rail 300 mm wide, 2.5 m in length fitted on a 'A' frame made with 45 x 45 x 5 mm angle iron section, 1.5m in height, horizontal rail painted (2coats) with yellow and white stripes, 150 mm in width at an angle of 450, 'A' frame painted with 2 coats of yellow paint, complete as per IRC:SP:55-2001)

1. Barricades on either side shall be measured individually.
2. Once barricade has been provided and work starts, removal of barricade will not be permitted till completion of work.
3. While erecting barricade, the bottom gap between barricade and existing ground should be plugged with cement concrete from inside, where required.
4. There should be minimum openings at the end of barricade to allow access of trucks / lorries and machine to site work area. Even these spaces should have proper opening & closing arrangements.
5. For 2.0m barricades adequate blinking lights on the barricade during nighttime must be ensured. The cost of this item should include provision for power packs / Genset etc. so as to ensure the blinking of lights in nighttime as long as barricades are in position at the work spot.
6. After completion of the entire work, the barricades shall be the property of the contractor.
7. If the cleaning is not done including removal of posters regularly, a recovery shall be made at the rate of 0.1% of the accepted rate of item per fortnight on pro-rata basis of length not cleaned.
8. The rates should be all inclusive for shifting/ erecting/ re-respecting the barricade for utility diversion/identification & road widening/diversions.
9. The barricading shall be provided as per Item, Specification, Drawing, only. Any type of change / modification will not be allowed without written permission of Engineer In charge, and in such case rate reduction will be imposed based on allowed barricading with written permission for specific area with valid reason.
10. Barricading of height 2.0m height as per tender drawing. Payment shall be made at 70% on the erection of the barricade and 30% on removal of barricade as per the instructions of Engineer.
11. It is specifically highlighted that barricading provided during construction shall be limited to 1m to 2m from outer edge of structure to be constructed. Barricading of height 2.0 m height as per GFCD. Payment shall be made at 70% on erection of barricade and 30% on removal of barricade after completion of project as per the instructions of Engineer.

Note: -

One-time payment shall be made for providing barricading from start of work till completion of work shifting. The barricading provided shall remain to be the property of the contractor on

completion of the work. Blinkers are to be installed on the barricading and rate for blinkers will be payable as per relevant item. Barricading is to be cleaned when required as per the instructions of Engineer in charge.

Work shall be carried out as directed by Engineer in charge

1. The relevant specifications as given in items shall apply to this item.
2. **The measurement shall be in per Each (Nos.) basis** of barricading for barricading sheet with proper numbering, structural steel, with necessary excavation, concrete base etc. including painting. Retro reflective work and blinkers shall be paid for in relevant item.
3. The rate includes labor, material, equipment, shifting of barricading as per requirement of progress of work and removal the same after completion of work. (All material will be the property of the contractor after completion of the project).
4. **The mode of payment shall be on a per Each (Nos.) basis.**

Item no. 16

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

MORT&H specification no. **202 (5th Revision)** shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

1. The work shall consist of removing as herein after setting forth existing concrete cover or RCC/PSC member etc. Which are in place but are necessary to be removed to carry out repair work on the members.
2. Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and other work to be left intact.
3. All operations necessary for the removal of any existing structure or part of which might endanger new construction/Repairing work shall be completed prior to the start of new work.
4. The structures shall be dismantled carefully, and the resulting materials shall be removed as not to cause damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.
5. Unless otherwise specified, the portion of bridges shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the requirement for the repair work.
6. Where directed by the Engineer-in-charge holes and depressions caused by dismantling operations shall be restored or repaired as original with approved materials and thoroughly finished with in line surrounding surface.
7. All materials obtained by dismantling shall be the property of the Government. Unless otherwise specified, materials having any salvage value shall be placed in a neat stack of like material within the right-of-way as directed by the Engineer-in-charge, for which contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged material.
8. All the products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or auctioned shall be disposed as directed,
9. The work of dismantling the structure shall be paid for in units by taking measures before and after, as applicable.
10. The contract unit rates for the various items of dismantling shall be for payment in full for carrying out the required operations including full compensation for all labor, materials, tools equipment, safeguard 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 material within all lifts and lead.
11. The rate shall be for all labor including breaking, removing obstructions as above mentioned, conveying and stacking/disposing off the same as may be directed by Engineer-in-charge.

- **Measurement shall be per Cum.**

Item No. 17: - Repair of crash barrier (Repair of concrete crash barrier with cement concrete of M-30 grade by cutting and trimming the damaged portion to a regular shape, cleaning the area to be repaired thoroughly, applying cement concrete after erection of proper form work.)

The work shall be executed as per specification of Item No. 11 with grade of concrete as mentioned in this item description

Item No. 18: - Repair of RCC Railing (Carrying out repair of RCC M-30 railing to bring it to the original shape).

2703 RAILING

2703.1 General

- a) Bridge crash barrier includes the portion of the structure erected on and above the kerb.
- b) crash barrier shall not be constructed until the centering false work for the span has been released and the span is self-supporting.
- c) For concrete with steel reinforcement, specifications for the items of controlled concrete and reinforcement mentioned under relevant Sections of these Specifications shall be applicable.
- d) The crash barrier shall be carefully erected true to line and grade. Posts shall be vertical with a tolerance not exceeding 6 mm in 3 m. The pockets left for posts shall be filled with non-shrink mortar.
- e) The type of crash barrier to be constructed shall be as shown on the drawings and shall conform to IRC:5 and IRC:6.
- f) Care shall be exercised in assembling expansion joints in the crash barrier to ensure that they function properly.
- g) The crash barrier shall be of such design as to be amenable to quick repairs.
- h) The material of metal crash barrier shall be handled and stored with care, so that it remains clean and free from damage. crash barrier materials shall be stored above the ground on platforms, skids, or other supports and kept free from grease, dirt and other contaminants.
- i) Any material which is lost, stolen or damaged after delivery shall be replaced or repaired by the Contractor.

Methods of repairs shall be such that they do not damage the material or protective coating.

2703.2 Railing

Materials, fabrication, transportation, erection and painting for bridge crash barrier shall conform to the requirements of Section 1900 of these Specifications.

All elements, pipe terminal Sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised or painted with an approved paint. If galvanised, all elements of the crash barrier shall be free from abrasions, rough or sharp edges, and shall not be kinked, twisted or bent. If straightening is necessary, it shall be done as per method approved by the Engineer.

Damaged galvanised surfaces, edges of holes and ends of steel crash barrier cut after galvanising shall be cleaned and re-galvanised.

The crash barrier shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout its length. Holes for field connections shall be drilled with the crash barrier in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawings, metal crash barrier shall be given one shop coat of paint and three coats of paint after erection, if sections are not galvanised.

crash barrier shall follow the alignment of the deck. Where required as per the drawings, the rail elements shall be before erection.

2703.3 Cast In-Situ Concrete Railing

The portion of the crash barrier or parapet which is to be cast in-situ shall be constructed in accordance with the requirements for Structural Concrete Section and reinforcement conforming to Sections 1600 and 1700 of these Specifications.

Forms shall be fabricated conforming to the shape of crash barrier shown on the drawings. It shall be ensured that no form joint appears on plane surfaces. For bridges/ viaducts of length more than 500 m horizontal slip forms shall be used for casting of crash barriers.

All mouldings, panel work and bevel strips shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean-cut and shall be free from cracks, spalls or other defects. Castings of posts shall be done in single pour.

2703.4 Cast In-Situ Concrete Railing

Precast members for railing/crash barrier shall be of reinforced cement concrete and shall conform to Sections 1600 and 1700 of these Specifications. The maximum size of the aggregate shall be limited to 12 mm and minimum concrete grade shall be M30 for railings and M40 for crash barriers. The precast members shall be removed from the moulds as soon as practicable and shall be kept damp for a period of at least 10 days, during which they shall be protected from sun and wind. Any precast member that becomes chipped, marred or cracked before or during the process of placing shall be rejected.

The item shall be measured & paid as finished work in RMT.

Item No. 19: - Repair of steel Railing (Repair of steel railing to bring it to the original shape)

This work shall consist **of Repair of steel railing to bring it to the original shape** shall be carried out as per relevant detailed specification of **Item No. 18 above**.

The item shall be measured & paid on weight basis in **Rmt.**

Item no. 20

Construction of RCC railing of M30 Grade in-situ with 20 mm nominal size aggregate, true to line and grade, tolerance of vertical RCC post not to exceed 1 in 500, centre to centre spacing between vertical post not to exceed 2000 mm, leaving adequate space between vertical post for expansion, complete as per approved drawings and technical specifications.

- 1 MORT&H specifications as in section, 1500 (P. No. 519), 2300(Pg. No-675), 2703 (P. No. 752) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
- 2 The measurement shall be given on **a running meter basis**.
- 3 The item includes reinforcement as per sketch attached.
- 4 The rate includes all materials, labor, equipment, plant, transportation etc. to execute this item.

Item no. 21

Removal of defective concrete, cleaning the surface thoroughly, applying the shotcrete mixture mechanically with compressed air under pressure, comprising of cement, sand, coarse aggregates, water and quick setting compound in the proportion as per clause 2807.1., sand and coarse aggregates conforming to IS: 383 and table 1 of IS: 9012 respectively, water cement ratio ranging from 0.35 to 0.50, density of gunite not less than 2000 kg/cum, strength not less than 25 Mpa and workmanship conforming to clause 2807.6.

Surface preparation is very important in all repair work, this should be carried out as per following procedure and using material as mentioned below. **Further work is to be done only after written acceptance of surface preparation quality from Engineer-in Charge.**

Material:-

- a) Electric light duty Chipper
- b) Hand Grinder
- c) Wire brush
- d) Compressor
- e) Electric Motor/water pump.
- f) Chisel & hammer.

Methodology:-

- a. Chip off entire loose gunite, if any,/concrete cover from the concrete elements, such as Slab, Girder, Diaphragm, Pier, Piercap, columns, beams, external walls as per requirement for any RCC / PSC unit of Bridge slabs soffit and other structural elements of concrete to be repaired.
- b. Chip off loose concrete from structural elements using chisel and hammer. Electrically operated chisel (Light duty Mechanical breaker / hammer) may be used. Debris should also be cleared once a day and area be kept clean. The loose concrete behind reinforcement, if any should be carefully removed. Corroded reinforcement should not be bent using chisel in order to create access. Only loose concrete should be taken out. This can be checked by lightly sounding the hammer over chipped area to ascertain any hollow sound on substrate.
- c. Removal of corrosion scales on corroded reinforcement bars should be done manually using sharp tools such as chisel to scrape rust scales from the surface. Thereafter use wire brushes to clean the surface of rebar. Since the brush would not be able to access behind the bars use emery paper to clean exposed surface as well as areas with difficult access. Rotary wire brushes, shaft type rotary wire brushes can be used in place of hand held brushes. Exposed concrete surface is also to be cleaned with wire brush/ rotary wirebrush to remove all the loose material, dust, dirt oil etc.
- d. Finally clean the area with high pressure water jet of suitable pressure and allow to surface dry.
- e. All exposed old reinforcement shall be cleaned using rust remover of approved make and then washed with clean water to remove traces of rust remover and finally allowed to dry.
- f. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply Two component epoxy-based zinc rich anti-corrosive primer Nitozinc Primer or equivalent material with the help of brush such that continuous film is formed on rebar and no rebar is left uncoated.
- g. Apply the Bonding agent on exposed surface for proper bonding between Old Surface and New Surface.
- h. After that, apply shotcrete of given specifications of approved make using pressure pump on the prepared surface of required thickness.
- i. Curing shall be done as per instruction of engineer in-charge.



TYPICAL IMAGE OF SURFACE PREPARED RCC MEMBER

Mode of Measurement & Payment: Surface area prepared and repaired shall be measured insq.mt for payment and shall be paid as per rates approved.

Features

- (i) High mechanical properties,
- (ii) High adhesion to different surfaces such as concrete, masonry, metal and stone,
- (iii) Solvent free,
- (iv) Structural adhesive with high wettability, suitable for bonding pultruded laminates and
- (v) Suitable for application on vertical or overhead surfaces.

Properties:

Table 6: Physical Properties of Epoxy Bonding Adhesive

Sr. no.	Properties	Components		
		Base	Hardener	Mixed
1	Colour	White	Black	Gray
2	Mixing ratio (parts) by weight	100	50	
3	Mixed density @ 25 deg C			1.73 – 1.88
4	* Pot life at 25 deg C			30 – 60 minutes
5	Yield (Pack)	20 kg	10 kg	

* Ambient Temperature will affect the pot life and setting time of the product and is inversely related

Table 7: Mechanical Properties of Epoxy Bonding Adhesive

Sr. no.	Properties	Standard	Details / Value
1	Compressive strength @ 25° C 7Days	ASTMC579	> 50 MPa

2	Tensile strength @ 25° C 7 Days	ASTMD638	> 15 MPa
3	Tensile modulus @ 25°C 7 Days	ASTMD638	>5 GPa
4	Flexural strength @ 25° C 7 Days	ASTMD790	>40 MPa
5	Flexural modulus @ 25°C 7 Days	ASTMD790	>5 GPa
6	Bond strength @ 25° C, concrete		>2 MPa (Concrete Failure)
7	Shear strength		> 11 MPa

Mixing Procedure

- (i) Full pack mixing is ideally suggested for accurate result,
- (ii) Part mixing suggested only if precise proportioning facility available at site,
- (iii) Mechanical mixing using low speed stirrer is suggested and
- (iv) Mixing till uniform color achieved of the mixed materials.

Application Procedure

- (i) Bonding surface must be cleaned from oil, grease, dust, curing compound, mould releasing agents, and any other material which affect the adhesion,
- (ii) Substrate residual moisture to be less than 4% and not to be applied on the substrate with rising dampness,
- (iii) Apply the mixed material with spatula or trowel on the substrate to achieve the required thickness and
- (iv) Application should cover all pinholes and surface undulations.

Measurement:

The measurement of payment shall be in **Sq. Mt.**

Item No. 22: - Removal of existing asphaltic wearing coat comprising of 50mm thick asphaltic concrete laid over 12 mm thick mastic asphalt including disposal with all lift and lead upto 1000m

1. This work shall consist of removing, as hereinafter set forth, existing culverts, bridges, pavements, kerbs and other structures like guard-rails, fences utility poles, manholes, catch basins, Inlets, etc. Which are in place but interfere with the new construction or are not suitable to remain in place, and, of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.
2. Existing culverts, bridges, pavements and other structures which are within the highway and which are designated to be removed shall be removed upto the limits and extent specified in the drawings or as indicated by the Engineer-in-charge.
3. Dismantling and removal operations shall be carried out with such 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 to the new construction. Removal of overlying or adjacent material if required in connection with the dismantling of the structure, shall be incidental to this item.
7. Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work* as dowels or ties shall, not be injured during removal of concrete.
8. Pipe culverts shall be carefully removed in such a manner to avoid damage to the pipes.
9. Steel structures shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawing or directed by the Engineer-in-charge that structure is to be removed in a condition suitable for re-erection, all members shall be mark 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 tallow 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 0.02 cubic metre 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 caused by dismantling operations shall be backfilled with excavated or other approved material and thoroughly compacted in line with surrounding area.
14. All materials obtained by dismantling shall be, the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like material within the right-of-way as directed by the Engineer-in-charge, for which Contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged material.
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, be stored in a neat and presentable manner. Structures or portions thereof which are specified in the contract for re-erections shall be stored in separate piles.
17. Timber or lumber from old structure which is designated by the Engineer-in-charge as materials to be salvaged shall have all nails and bolts removed therefrom and shall be stored in neat piles in locations suitable for loading.
18. All the products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or

auctioned shall be disposed as directed, within 100 metres.

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

(I) Dismantling brick/concrete (Plain and Reinforced), masonry	Cubic Metre
(II) Dismantling flexible and cement concrete pavement.	Cubic Metre
(III) Dismantling steel structure.	Tonne
IV) Dismantling timber structure.	Cubic Metre
(V) Dismantling pipes, guard rails, kerbs, gutters and fencing.	Meter
(VI) Utility poles	Nos

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

Mode of Payment: The payment shall be made on Cum basis of work done.

Item No. 23: - Bituminous Concrete Grading (Providing and laying bituminous concrete with higher capacity batch type hot mix plant using crushed aggregates of specified grading, premixed with bituminous binder @ 5.2 per cent of mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to- achieve the desired compaction as per MORTH specification clause No. 507 complete in all respects)

MORTH specification -507 (Pg. No-188) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on Cum basis of work done.

Item No. 24: - Dismantling the Existing Expansion Joint by Pneumatic Breaker without damaging to the existing reinforcement and removal by cutting with Gas Cutter and Breaking of Concrete up to 0.5 m on both side of joint by Mechanical means including Disposal of malba/ debris and Fixing of New Strip Seal Expansion Joint as per drawing including necessary welding, rebaring, fixing of Shuttering & centring and Providing, laying, mixing, vibrating, curing and roughening the surface of reinforced cement concrete (with ordinary Portland cement @ 500 kg/m³) of grade 53 to required levels and shape at all height and depth using 20 mm max size graded aggregate as specified and directed in repair of expansion joints etc. with Ready Mixed (Automatic batch mix Plant) of M-50 grade(25Mpa minimum 1 day.) rapid hardening type concrete and self - flowable properties with minimum flow of 450 mm at the time of pouring with bonding coat between old and new concrete curing complete as per the direction of the Engineer -in-Charge.

1. This work shall consist of removing, as here in after set forth, existing culverts, bridges, pavements, kerbs and other structures like guard- rails, fences utility poles, manholes, catch basins, Inlets, etc. Which are in place but interfere with the new construction or are not suitable to remain in place, and. of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.
2. Existing culverts, bridges, pavements and other structures which are within the highway and which are designated to be removed shall be removed upto the limits and extent specified in the drawings or as Indicated by the Engineer-in-charge.
3. Dismantling and removal operations shall be carried out with such 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 60 salvaged, the part of the structure to be retained and any other properties or structures nearby.
6. Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material if required in connection with the dismantling of the structured, shall be incidental to this item.
7. Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work* as dowels or ties shall, not be injured during removal of concrete.
8. Pipe culverts shall be carefully removed In such a manner to avoid damage to the pipes.
9. Steel structures shall unless otherwise provided be carefully dismantled In such a manner as to avoid damage to members thereof. If specified In the drawing or directed by the Engineer-in-charge that structure is to be removed In a condition suitable for re-erection, all members shall be match marked by the contractor with white lead paint before dismantling end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location, all pins, pin holes and machined surfaces shall be painted with a mixture of white lead and tallow 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 0.02 cubic metre 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 caused by dismantling operation's shall

be backfilled with excavated or other approved material and thoroughly compacted in line with surrounding area.

14. All materials obtained by dismantling shall be, the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like material within the right-of-way as directed by the Engineer-in-charge, for which Contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged material.
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, be stored in a neat and presentable manner. Structures or portions thereof which are specified in the contract for re-erections shall be stored in separate piles.
17. Timber or lumber from old structure which is designated by the Engineer-in-charge as materials to be shall have all
Ralls and bolts removed therefrom and shall be stored in neat piles locations suitable for loading.
18. All the products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or auctioned shall be disposed as directed, within 100 metres.
19. The work of dismantling structures shall be paid for in units indicated below by taking measurements before and after, as applicable.
 - (I) Dismantling brick/concrete (Plain and Reinforced), masonry Cubic Metre
 - (II) Dismantling flexible and cement concrete pavement. Cubic Metre
 - (III) Dismantling steel structure. Tonne
 - (IV) Dismantling timber structure. Cubic Metre
 - (V) Dismantling pipes, guard rails, kerbs, gutters and fencing. Linear Metre
 - (VI) Utility poles. Nos.
20. The contract unit rates for the various items of dismantling shall be payment in full for earning out the required operations including full compensation for all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work. These will also include excavation and backfilling where necessary and for handling, salvaging, piling and disposing of the dismantled materials within all lifts and upto a lead of 100 metres.

Mode of Payment: The payment shall be made on Cum basis of work done.

Item No. 25: -

Rust Removal & Steel Protection:- Cleaning as directed & specified all corrosion / rust / scales from reinforcement bars using rust remover Reebakleens RR of Fosroc make or Rust clean of BASF or equivalent of leaving to dry for 30 mins & washing surface with fresh water as required to exposed reinforcement bars complete as specified also providing & applying inhibition coats/system to exposed reinforcement bars after drying & also new bars after cleaning & removing scales and rust completely as specified. Two component inhibitors Concrese ZRI equivalent material of BASF make as approved by engineer shall be used as per manufacturers specification in two coats including all labor tools tackles, necessary surface preparation & necessary protection after & during repair work.

Cleaning of rust / scales / corrosion from reinforcement bars should be carried out using rust remover, Reebakleens RR of Fosroc. The material is to be applied to the rusted metal bar, using brush and leaving it to dry for 30 Mins. & washing surface with fresh water as required to exposed reinforcement bar including labor, tools, scaffolding, electricity, plant and machinery complete as per detail specification and as directed by Engineer-in-charge.

Corrosion protection of existing (OLD) reinforcement is very necessary in order to carry out durable repair of concrete structure, first the existing corrosion has to be removed, and protection of rebar shall be done by using protective coating on rebar using specification as per relevant items.

Material:-

1) Rust Removal:

Reebakleens RR (Fosroc) or Rustoclean (BASF):-

Reebakleens RR a cleaning agent is combination of acid-based material, corrosion inhibitors and dispersing agents and is supplied as a clear green solution with specific gravity of 1.16 - 1.22 @ 25 degree C or equivalent shall be used.

Methodology: -

a. All exposed old reinforcement shall be cleaned using rust remover Reebakleens RR of Fosroc or equivalent and then washed with clean water to remove traces of rust remover and finally allowed to dry.

3.0 ANTI CORROSIVE TREATMENT TO STEEL: -

Providing & applying bi-polar inhibition coats/system to exposed reinforcement bars & also new bars, after cleaning & removing scales and rust completely as specified in 2.0, Two component inhibitor Nitozinc Primer std. of Fosroc or MasterEmaco P130 of BASF having Mix density of 2.4 and solid content 57(+/-3) Adhesive bond strength > 1.5 N/mm², 40 microns DFT per coat as approved by engineer-in-charge shall be used as per manufacturer's specification in two coats including all labors, tools and machineries, plants, scaffolding, necessary surface preparation and necessary protection after and during work.

Material: -

1) Anti-corrosive coating:

Nitozinc Primer std. (Fosroc) or MasterEmaco P130 (BASF):

Nitozinc Primer Std. of Fosroc, combination of two component system based on metallic zinc

and epoxy resin which on mixing gives a grey colored liquid with total solid content of more than 40% and DFT of more than 40 Microns.

Methodology: -

a. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply zinc rich epoxy coating using Nitozinc Primer std. of Fosroc or equivalent with the help of brush such that continuous film is formed on rebar and no rebar is left uncoated.

Mode of Measurement & Payment:

Concrete Surface area prepared for carrying out repair or treatment shall be measured in sq.mt for payment and shall be paid as per rates approved.

Item no. 26

Epoxy bonding agent of new concrete to old concrete. The applied bond agent should possess min properties as below: Shear Strength - @ 7 days 20N/mm² Flexural Strength - @ 7 days 35 N/mm² Compressive Strength - @ 7 days 50N/mm² (The new repair mortar/concrete should be applied within overlay time of epoxy bonding agent mentioned as per manufacturer's datasheets)

2805 EPOXY BONDING OF NEW CONCRETE TO OLD CONCRETE

2805.1 Epoxy resin used for bonding shall be obtained from a reputed manufacturer. The pot life of such bonding epoxy shall not be less than 60 minutes at normal temperature.

2805.2 The entire surface of the existing concrete member should be thoroughly cleaned by wire brush and then with compressed air to remove dust and loose particles from the surface. Any crack or spalling of concrete shall be sealed by epoxy injection/epoxy mortar/grouting as decided by the Engineer. A coating of suitable epoxy resin at the rate of 0.8 kg/sq.m (minimum) should then be applied on the surface of the existing concrete members. Fresh concrete shall then be placed within the pot life of the resin system.

2805.3 Testing

2805.3.1 Epoxy used for bonding work shall satisfy the criteria mentioned in

Clause 2803.9.

2805.3.2 Two concrete cubes of 150 mm size cast as per approved design mix shall be placed at a distance of 150 mm from each other, as shown in Fig. 3 of Appendix-2800/1. Epoxy resin system suggested for bonding new to old concrete shall be applied on the opposite faces of the cubes.

Fresh cement concrete cube of grade as per approved design mix shall be cast with water cement ratio of 0.4 or less in the manner shown in Fig. 3 of Appendix 2800/1. The assembly shall be cured in water for 28 days and steel spacer removed thereafter. The cube assembly shall be subjected to compression load after 28 days of curing, thereby subjecting the bond to shearing load. Failure must not occur at this joint.

MEASUREMENTS FOR PAYMENT

Epoxy Bonding of New Concrete to Old Concrete shall be measured in square meter. RATE

The contract unit rate for Epoxy Bonding of New Concrete To Old Concrete shall include the cost of all labor, material, tools and plant & machinery required for completing the work as per these Specifications.

Item no. 27

Guniting concrete surface with cement mortar applied with compressor after cleaning surface and spraying with epoxy complete as per Technical specification. (Reference to MORT&H's specification 2807)

2807 GUNITING/SHOTCRETING

2807.1 The gunite shall comprise 100 parts by weight of cement, 300 parts by weight quartz sand, 35-50 parts by weight water and 2 parts by weight approved quick setting compound. In general, dry mix shotcrete shall be used.

2807.2 Ordinary Portland cement conforming to IS:269 shall be used in guniting.

2807.3 Sand for guniting shall comply with the requirements stipulated in IS: 383. In general, sand should neither be too coarse to increase the rebound nor too fine to increase the slump. Sand should preferably have moisture content between 3 to 6 percent.

The grading of sand shall lie within the limits given below:

IS Sieve	Percent Passing the Sieve Designation 4.75 mm 95—100
2.36 mm	65—90
1.18 mm	45—75
600 micron	30—50
300 micron	10—22
150 micron	2—8

2807.4 For thick sections it may be advantageous to incorporate coarse aggregate in the mix provided adequate guniting equipment is available. Coarse aggregate, when used, shall conform to grading given in Table-1 of IS:9012. The percentage of coarse aggregate may normally be kept as 20 to 40 percent of the total aggregate and the mix shall be suitably designed.

2807.5 Water/cement ratio for guniting shall fall within the range of 0.35 to 0.50 by mass; wet enough to reduce the rebound. Drying shrinkage may be between 0.06 percent and 0.10 percent. The quick setting compound shall be added at the nozzle with water just before guniting.

2807.6 Workmanship

The cement and sand shall be batched and mixed and conveyed through a hose pipe with the help of compressed air. A separate line shall bring the water under pressure. The cement, sand and water mix shall be passed through and intimately mixed in a special manifold and then projected at high velocity to the surface being repaired. The density of gunite shall not be less than 2000 kg/cu.m. The strength of gunite shall not be less than 25 MPa. For effective guniting, the nozzle shall be kept 600 mm to 1500 mm away from the surface, preferably normal to that surface. While enclosing reinforcement bars during repairs the nozzle shall be held closer at a slight angle and the mix shall be wetter than the normal.

2807.7 Test panels simulating actual field conditions shall be fabricated for conducting preconstruction testing. The procedure for testing the cubes or cylinders taken from the panels stipulated in Clause 6 of IS:9012 shall be followed.

2807.8 It should be ensured from tests that strength of about 25 MPa at 28 days is available for the mortar/concrete mix.

2807.9 The defective concrete shall be cut out to the full depth till sound concrete surface is reached. Under no circumstances should the thickness of concrete to be removed be less than clear cover to the main reinforcement. No square shoulders shall be left at the perimeter of the cut-off portion and all edges shall be tapered. Thereafter, all loose and foreign materials should be removed and the surface sand blasted to make it rough to receive shotcrete after applying a coat of epoxy bonding as per recommendation of the manufacturer at the rate of 1.0 kg per 1.5 sq.m. of surface area.

2807.10 The exposed reinforcement shall be thoroughly cleaned free of rust, scales etc. by wire brushing.

Wherever the reinforcements have been corroded, the same shall be removed and replaced by additional reinforcement. Before application of gunite, a coat of neat cement slurry should be applied on the surface of the reinforcement.

2807.11 Sufficient clearance shall be provided around the reinforcement to permit encasement with sound gunite. Care shall be taken to avoid sand pockets behind the reinforcement.

2807.12 A thickness of 25 mm to 40 mm of gunite can norma(ly be deposited in one operation. If, for some reason, the total thickness is to be built up in successive operations, the previous layer should be allowed to set but not become hard before the application of the subsequent layer. Guniting shall always be done on a damp concrete surface.

2807.13 Where required, welded wire fabrics 50 mm x 50 mm x No. 10 gauge shall be provided in the first layer of guniting. The fabric shall be tied properly. In case the damage to the concrete member is very deep, the specifications for guniting as well as requirement of placement of wire mesh, has to be decided as per field conditions.

2807.14 The stipulations given in IS:9012 regarding application of gunite should be followed so as to keep the rebound to the minimum. The quality of guniting and workmanship shall be such that the percentage of rebound mentioned in IS:9012 can be adhered to. In no circumstances shall the rebound material be re-used in the work.

2807.15 It would be desirable that green gunite is moistened for at least 7 days. Guniting work shall not be done during windy or rainy conditions.

2814 MEASUREMENTS FOR PAYMENT

For epoxy grouting measurement for sealing of cracks and injection shall be made by weight of epoxy consumed in kg for epoxy grouting. For provision of nipples required for grouting, the payment shall be for number of nipples inserted.

b) For cement grouting measurement for sealing of cracks and injection shall be made by weight of cement consumed in kg.

c) Measurement for application of epoxy mortar/protective surface coating of concrete for specified thickness shall be in square meter of surface area of application.

d) Bonding of old and new concrete by epoxy mortar shall be measured in square meter of surface area of interface.

e) Guniting/shotcreting shall be measured in square metre of surface area of application.

f) Replacement/rectification of bearings shall be measured in number of bearing assembly replaced/rectified.

g) Dismantling of wearing coat shall be measured in square meter of area of wearing course dismantled.

External pre-stressing shall be measured in tones of H.T. steel strand/wire measured from anchorage to anchorage before stressing.

2815 RATE

The contract unit rate for sealing of cracks and injection of cement grout shall include cost of all materials, labor, tools and plant, placing in position, testing, curing and other incidental expenses for the satisfactory completion of the work as per these Specifications.

The contract unit rate for application of epoxy mortar/protective surface coating for specified thickness shall include cost of all materials, labor, tools and plant, placing in position, testing and other incidental expenses including surface preparation for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

The contract unit rate for guniting/shotcreting shall include cost of all materials, labor, tools and plant, placing in position, testing, curing, surface preparation and other incidental expenses including the provision of nipples for the satisfactory completion of the work as per these Specifications.

The contract unit rate for replacement/rectification of bearings shall include cost of all materials, labor, tools and plant, placing in position, site welding/riveting/bolt connections, operation of jacks and other incidental expenses for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

The contract unit rate for dismantling of wearing coat shall include cost of all materials, labor, tools and plant, traffic management, signages, safety precautions and other incidental expenses including removal of existing expansion joints, if included as a part of the work by the Engineer for the satisfactory completion of the work as per these Specifications.

The contract unit rate for external pre-stressing shall include cost of all materials, labor, tools and plant, temporary works, testing, curing and other incidental expenses including careful monitoring of the deflection of girders being externally pre-stressed for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

Item no. 28

Providing and inserting nipples with approved fixing compound after drilling holes for grouting as per Technical specifications including subsequent cutting/removal and sealing of the hole as necessary of nipples after completion of grouting with Cement/Epoxy.

4.0 INJECTION GROUTING- MICROFINE CEMENT: -

Providing and fixing Injection ports/nozzles in staggered manner on all sides of member at @

0.5 Mtr c/c spacing / as per technical specification after drilling holes , to facilitate injecting microfine cement, using quick setting material or epoxy putty and providing and executing injection/pressure grouting in prefixed nozzles/ports using Alcofine 1108 SR with Blaine fineness more than 8000 sqcm/gm, compressive strength of more than 50 N/sqmm in 7 days and adding water for required consistency till no further grout is accepted by ports using grout pump including all material, labor, chemical, machineries, tools, plants, electricity, curing etc. complete as directed by Engineer-in-charge.

Material:

- a. Alcofine 1108 SR Microfine Cement of CMPPL.
- b. Tamcrete MFC of Normet
- c. Renderoc Plug of Fosroc

Renderoc Plug is supplied as a ready to use blend of dry powders which requires only the addition of clean water at site to produce a highly consistent, rapid setting mortar which is easy to apply in many difficult conditions. The material is based on a blend of cements, graded aggregates, special fillers and chemical additives which control the rate of set and minimize the risk of thermal cracking.

- d. Killick Nixon type injection grout pump or equivalent.

Methodology:

Treatment for Honeycombed Areas in RCC elements and Making Concrete Dense by grouting in grid pattern etc.

In case it is noticed that the R.C.C. elements have honeycombing inside after removal of loose concrete material, it is necessary to inject Microfine cement GROUT in the honeycombed areas and all part of concrete structure in order to fill all the voids/gap and make concrete denser.

- a. First of all, a hole of about 16 mm dia. is to be drilled into the honeycombed area, construction joints, and in grid pattern of 0.5 Mt distance in all area. The depth of the drilled hole should be about 300 mm. (in case of slabs and such thin elements the drilled hole depth to be 40-60 % of the element thickness). Use compressed air to clean the hole, as well as honeycombed area to remove dust and dirt. Then a 12 mm dia. Flexible PVC injection nipple is to be fixed into the hole. Seal the surface around the nipple with Pre-packed material like Renderoc Plug of Fosroc or equivalent or using Pre packed Polymer modified mortar, these would ensure that the injected grout does not leak from the gaps.
- b. In case of the honeycombed areas fix nipples and repair the honeycombed patch with pre-packed Polymer modified mortar of approved manufacturer.
- c. In case of grouting to make concrete dense, fix nipples in grid pattern of 500mm distance.
- d. The preparation done as above should be allowed to cure for 24 hours.
- e. Prepare the polymer modified cementitious grout with following mix proportion.
 - i. 25 kg Alcofine 1108 SR Microfine cement bag
 - ii. 10 to 12.5 ltr. Water

The above mix should be mixed in a container and stirred well for 5 minutes and used before setting of material.

- f. Use 140 PSI grade Killick Nixon type & make injection grout pump or equivalent.
- g. Injection should start from bottom most nipple (or from one end to another in case of horizontal crack) and proceed progressively to subsequent nipples. Once the grout comes out of the upper or next nipple the nipple being injected should be closed and gun should be connected to next nipple. Sometimes if the path

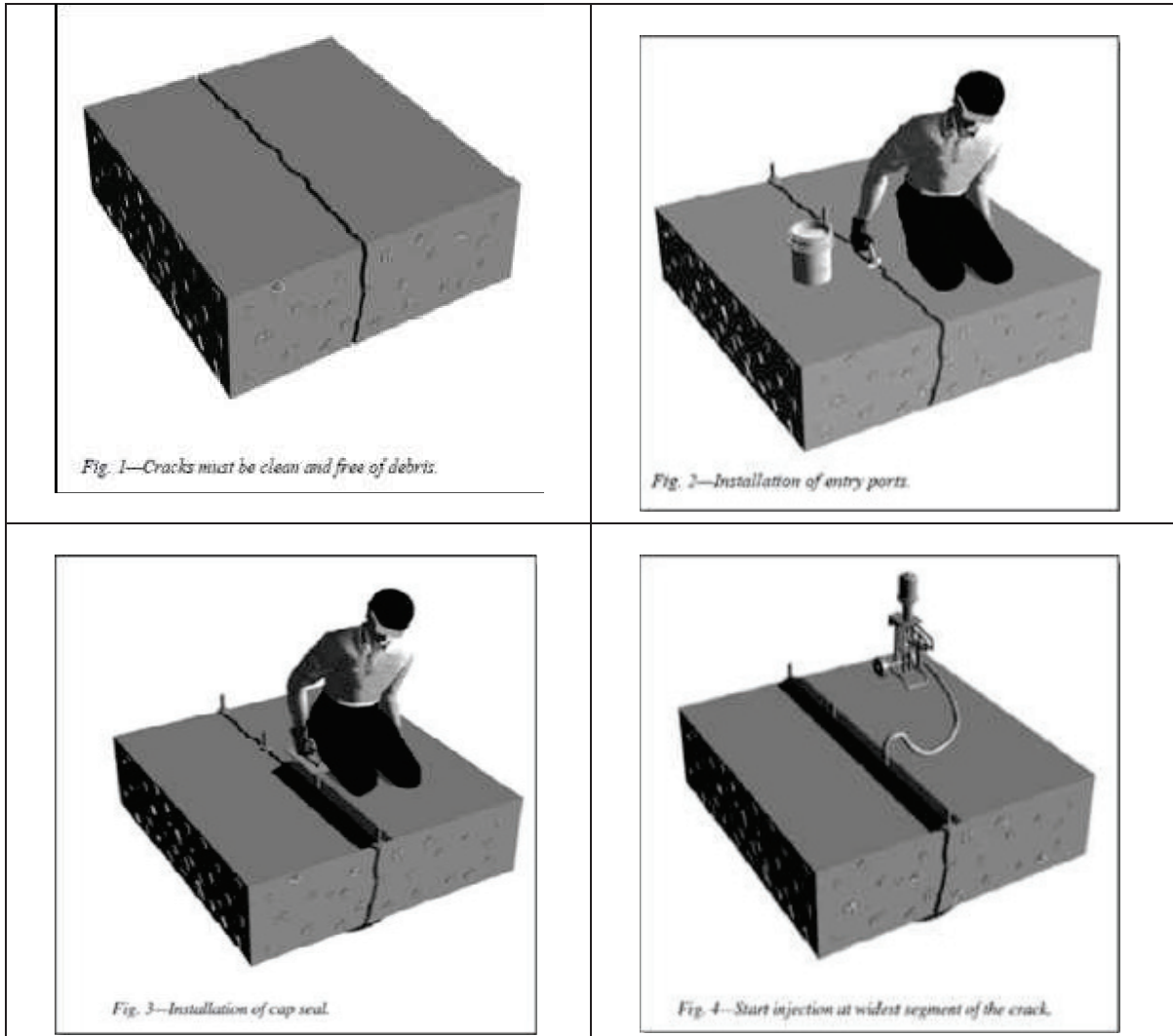
is not continuous there may be resistance to injection (no grout flows in spite of maintaining the maximum pressure for 3-5 minutes). In such a situation proceed to the next nipple.

h. After completing the injection allow it to cure for 24 hours. Then remove the nozzles and seal the holes with pre-polymer modified mortar.

Mode of Measurement & Payment:

The item shall be measured & paid as finished work in Nos.

STEPS INVOLVED IN STRUCTURAL CRACK REPAIR BY INJECTION GROUTING



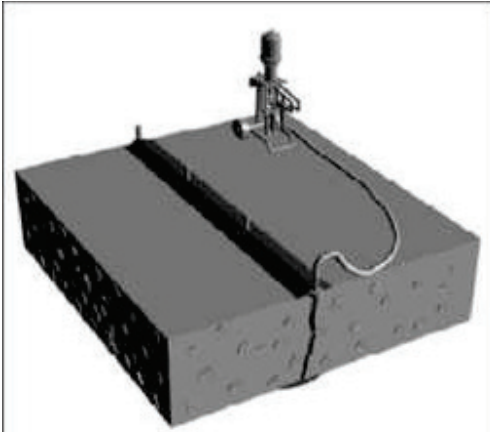


Fig. 5—Continue injection until refusal.



Fig. 6—Remove cap seal.

Item No. 29:- Sealing of cracks/porous concrete by injection process through nipples/Grouting complete as per Technical specification.

Sealing the Cracks: The opened crack between two packers shall be sealed with epoxy putty. When mixed, the product achieves a paste type consistency which can be applied with thin metal piece. The material shall be carefully pressed into the crack to fill the entire depth of the crack and troweled at the top making it in line with existing concrete surface. The epoxy putty shall be allowed to set completely before initiating the injection process. This would take typically 20 to 30 minutes depending on the ambient temperature.

2803.1 General

The work of structural bonding of concrete using epoxy adhesive shall conform to these Specifications.

2803.2 The Contractor shall furnish a method statement giving details of methodology of construction, sources of supply of materials, tools, equipment, and appliances to be used on work, personnel and supervision.

2803.3 Personnel

The Contractor's personnel shall be qualified and experienced in epoxy injection process.

2803.4 Material

The material for injection shall be suitable two-component low viscosity epoxy resin, having the required characteristics of bonding with concrete and resistance to moisture penetration.

Epoxy mortar or polysulphide resin may be used for sealing the surface.

The material for epoxy injection shall conform to the following:

- i) The resin and hardener shall be mixed by weight and the mixing ratio shall generally be between 1 pbw (parts by weight) to 50 pbw subject to manufacturer's recommendation.
- ii) Neither the mixed epoxy adhesives nor their individual component shall contain solvents and thickeners.
- iii) The components shall be free of lumps or foreign material. The viscosity of the individual components shall not change more than ± 15 percent kept in closed containers at 25°C after two weeks.
- iv) Consistency of mixed adhesive shall satisfy the requirements given in Table 2800 -1.

Table 2800-1: Consistency of Adhesive

		Standard Version (cps)	Low Viscosity Version (cps)
i)	Viscosity of Mixed Adhesive at 25°C	(200-300)	(100-190)
ii)	Pot Life of mixed adhesive at 25°C	1 hour \pm 15 minutes *	
iii)	Set time of mixed adhesive at 25°C	3-6 hours	

* In the case of two component injection system where resin and hardener get mixed at point of injection pot life at 25°C shall be not greater than 15 minutes \pm 10 minutes.

2803.5 Equipment for Injection

The equipment shall be portable positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at nozzle. The pumps shall be generally electrically powered and shall provide in-time metering and mixing. The tolerance on mix ratio shall be 5 percent by volume. The injection equipment shall have automatic pressure control capable of discharging mixed

adhesive at any pre-set pressure within the prescribed limits and shall be additionally equipped with a manual pressure control.

The injection equipment shall be equipped with sensors on both the components A and B

reservoirs that will automatically stop the machine when only one component is being pumped to the mixing head.

If considered appropriate, suitable compressed air operated epoxy injection gun can be used with prior approval of the Engineer for manual injection of mix when resin and hardener had been mixed in a separate unit.

2803.6 Preparation

Surfaces adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil efflorescence or other foreign matter by brushing/water jetting/sand blasting. Acids and corrosives shall not be permitted for cleaning.

Entry ports shall be provided along the crack at intervals of not more than the thickness of concrete at the location.

Surface seal shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces.

Before proceeding with the injection, it shall be ensured that the surface seal has gained adequate strength corresponding to concrete strength of the member and to withstand the injection pressure.

2803.7 Epoxy Injection

Injection of epoxy adhesive shall begin at the lowest entry port and continue until the epoxy adhesive appears at the next adjacent entry port. The injection shall then be discontinued at the first entry port which shall be sealed. Thereafter, epoxy injection shall be carried out from the next adjacent port and continued successively from each port until the crack is completely filled.

If travel of epoxy adhesive from one port to the next does not occur, the work shall be stopped immediately. In case the volume of the injected material exceeds 2 litres for a particular entry port, the work shall be stopped and the specifications may be reviewed.

2803.8 Precautions for Application

- a) Temperature of components A and B, i.e., resin and hardener shall be between 1°C and 35°C at the time of mixing unless otherwise specified.
- b) Temperature of structural member during epoxy injection shall be between 10°C and 35°C unless otherwise specified.
- c) Immediately prior to use, each component shall be thoroughly mixed with a clean paddle. The paddle shall be of a type that does not propel air into the material. Separate clean paddle must be used for each component.
- d) Any heating of the adhesive components shall be done by application of indirect heat, in case the work is to be done in cold climate.
- e) Just before use, the two components shall be thoroughly mixed in the ratios specified by the manufacturer. The mixing time shall be strictly in accordance with manufacturer's recommendations. When adhesives with different coloured components are mixed, the mixture shall have a uniform colour without streaks.

- f) The use of solvents and thinners shall not be permitted except for cleaning of equipment.

2803.9 Testing

2803.9.1 Material Testing

Prior to approval of material, the following tests shall be carried out by the Contractor at site or in an authorised laboratory for each batch of resin and hardener and each combination.

- i) Viscosity test for resin and hardener and the mix: three specimens each.
- ii) Pot life test: three specimens each.
- iii) Bond test: three specimens each.
- iv) Shear test: six specimens each, 3 after 24 hours and the other three after 72 hours of curing. Subsequent tests shall be carried out as directed by the Engineer. Procedure for tests shall be as below:

i) Pot Life Test

- a) 500 gm of resin formulation shall be prepared by thoroughly mixing the resin and hardener I accelerator I catalyst component in proposed proportion in a 1 kg capacity hemispheric porcelain bowl by means of a spatula or any other agitating device and time and the ambient temperature noted.
- b) The resin formulation shall be applied with a clean dry 25 mm size painter's brush, on a clean dry surface such as cement concrete over 150 mm- 200 mm length, starting immediately after mixing the formulation and repeating the operation every five minutes. When it becomes just difficult to spread the resin properly with the brush, the time is noted. The time elapsed since completion of mixing of resin formulation, is taken as its pot life.
- c) One pot life test shall be performed on commencement of work and the same shall be repeated every four hours.
- d) In case the material fails to satisfy the pot life test, it shall not be used for injection.

Where the resin and hardener get mixed at point of injection, the pot life is not important and no tests may be required.

ii) Bond Test

A standard 150 mm diameter and 300 mm long concrete cylinder shall be cast in 2 pieces by providing a separating medium at an axis of 45 degrees to the longer axis of the cylinder as shown in Fig. 1 of Appendix 2800/1.

Three such split cylinders shall be prepared. Two pieces of each cylinder shall be joined with epoxy mortar at four points to give a clear gap of about 0.2 mm, which will be injected with epoxy resin at site. After epoxy has been cured, load test shall be carried out on the cylinder. The failure shall not take place at the joint injected with epoxy resin. Also the strength of cylinder at failure shall not be less than 80 percent of the 28 days cube strength of the concrete mix.

iii) Shear Tests

Two steel plates, minimum 3 mm thick, shall be bonded with epoxy at site using the same resin mix as used/proposed to be used for injection. The assembly shall be kept in mechanical clamp till epoxy is cured. A total of six specimens shall be prepared for each batch of materials. Three test specimens shall then be subjected to a shear force along the axis after 24 hours and the minimum shear strength before failure shall not be less than 1 MPa (Refer Fig. 2 of Appendix 2800/1).

The remaining test specimens shall be similarly tested after 72 hours of curing. The shear strength before failure shall not be less than 2.5 MPa.

2803.9.2 Core Test

If directed by the Engineer, cores shall be tested for the acceptance of the work. The selection of the location of cores shall be as directed by the Engineer in such a way that damage in critical/stressed areas of the structure is avoided.

The Contractor shall obtain 50 mm diameter initial core samples in the first 50 linear metres. Thereafter, frequency of core sampling shall be as specified or as agreed by the Engineer. The depth of the core shall normally be less than 200 mm.

Tests and Acceptance Criteria shall be as follows:

- a) Penetration- Visual examination of the core should show epoxy adhesive filling a minimum of 90 percent of the crack.
- b) Bond Strength- When tested for bond, concrete failure should occur before adhesive failure. Also, minimum bond strength of 40 MPa should be developed with no failure of either concrete or adhesive.

if the cores taken in first 50 m length pass tests as specified above, epoxy adhesive injection work at area represented by cores will be accepted.

If cores fail either by lack of penetration or bond strength, work shall not proceed further until the areas represented by the cores are re-injected and re-tested for acceptance.

Filling of Core Holes

Two-component bonding agent shall be applied to surfaces of cored holes followed by filling of non-shrink cement grout mix placed by hand trowel, thoroughly rodded and tamped in place. The surface shall be finished to match the finish and texture of existing concrete to the satisfaction of the Engineer. Materials to be used and procedures for filling core holes shall be got approved by the Engineer before proceeding with work.

2803.9.3 Test for Injection Equipment

At all times during the course of the work, the Contractor shall keep complete and accurate records and make available to the Engineer, the results of the pressure and ratio tests specified below so that the efficacy and accuracy of the injection equipment is verified. The Engineer at any time may direct the Contractor to conduct additional tests in his presence.

Pressure Test

The mixing head of the injection equipment shall be disconnected and the two adhesive component delivery lines shall be attached to the pressure check device, which shall consist of two independent valved nozzles capable of sensing the pressure. The check device shall be closed and equipment operated until the gauge pressure in each line reads 5 MPa. The pumps shall be stopped and the gauge pressure shall not drop below 4 MPa within 2 minutes.

The pressure test shall be run for each injection unit at the beginning and after break of every shift.

Ratio Test

The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device, which shall consist of two independent valved

nozzles. There shall be a pressure gauge capable of controlling back pressure by opening or closing valved nozzles capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to read 5 bar for both adhesive components, which shall be simultaneously discharged into separate calibrated containers during the same time period. The amounts thus discharged shall be compared to determine whether the volume/discharge conforms to the manufacturer's recommended ratio for applicable material.

The Measurement & payment will be made on KG basis of the finished work.

Item no. 30

Providing pre-moulded asphalt filler joints as per drawings. (A) 12mm

- Open joints shall be constructed at the locations as directed by the Engineer-in charge using a wood strip, metal plate, other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete at the joints shall be edge finished. Reinforcement shall not extend across as open joint.
- When performed filler is to be provided the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab, care shall be taken to prevent the former from being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose material sticking to it.
- The material used for filling expansion joint shall be bitumen impregnated felt which shall conform to the requirements of IS : 1838, and shall be got approved from the Engineer-in-charge.
- The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.
- **The expansion joint shall be measured in Square meters.** Width of the expansion joint shall be equal to full depth of the slab.
- The rate shall include the cost of all materials, labor, equipment and other incidental charges for fixing the joints complete in all respect as per these specifications and as shown in the drawings.

Item no. 31 : Strip Seal Expansion Joint (Providing and laying of a strip seal expansion joint catering to maximum horizontal movement upto 70 mm, complete as per approved drawings and standard specifications to be installed by the manufacturer/supplier or their authorised representative ensuring compliance to the manufacturer's instructions for installation.)

MORT&H specification -2606 (Pg. No-728) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on Cum basis of work done.

Item no. 32 Providing and placing in position FE 500D TMT bar reinforcement including cutting, bending, hooking, and tying complete as per detailed drawing. (C) Balanced cantilever box type superstructure. (I) Deck slab (II) Webs, Bottom slabs and Diaphragms

1. **MORT&H specifications as in section 1600(5th revision)** (Pg. No-527) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
2. **The measurement shall be as per 1608 of section 1600 (5th Revision)** (Pg. No-531) . “Reinforcement shall be measured in length including hooks, if any separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in Tonnes on the basis of IS-1732, wastage, Overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement. “

The measurement in Metric Tonnes, The Rate shall be as per 1609 of section 1600(Pg. no-532).

3. The rate includes conveying to site all required materials ,cost of required materials, plants, labor, fabrication, placing in position etc. to complete the item.
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Item no. 33 Applying epoxy mortar over leached, honey combed and spalled concrete surface and exposed steel reinforcement complete as per Technical specification

1. Material

The epoxy resins for use in the mortar shall be obtained from a reputed manufacturer and shall conform to the following:

Pot Life	60 minutes at 30°C
Bond Strength	12 MPa
Tensile Strength	16 MPa

The Contractor/user shall carry out tests on the samples to demonstrate that the above requirements are met.

The sand to be used in the mortar shall be graded quartz sand

2. Proportioning and Mixing

The resin and hardener shall be first mixed. Thereafter, dry filler shall be added and again mixed thoroughly. The resultant mix shall be free of lumps of dry filler and shall be of uniform colour. For a total weight of 1 kg or less, the components shall be mixed for 3 minutes in a slow speed (400-600 rpm) mixer. The stirrer shall be moved up and down and along the sides until uniform colour without streaks, is obtained. While stirring, it shall be ensured that excessive amount of air is not entrapped. If no power is available, a flat putty knife may be used to reach into the corners of the can and hand mixing done for at least 5 minutes.

3. Surface Preparation

Two general methods of surface preparation shall be followed:

- a) Mechanical that includes grinding, grit blasting, water blasting and scarification.
- b) Chemical that includes acid etching with 15 percent by weight of hydrochloric solution, followed by repeated flushing with high pressure stream of water

Contaminants, such as oil, grease, tar, asphalt, paint, wax, curing compounds, surface; impregnants like linseed oil or silicones and laitance, loose material and unsound concrete, shall be removed from the surface on which epoxy mortar is to be placed.

4. Application

The epoxy primer coat which acts as a bonding agent, shall consist of resin and hardener mixed in the proportions as given by the manufacturer. Epoxy bonding agent shall be applied only on a dry surface and shall not be applied when it rains or in standing water. The

overlay, whether epoxy or cement based, shall be done within the pot life of the epoxy primer coat. Epoxy primer coat shall be applied with the help of stiff nylon bristle brushes or hard rubber rollers or spray gun, depending upon the nature of surface and extent of work area. As far as possible, the coating shall be uniformly thick.

Before the primer coat is fully cured, epoxy mortar shall be applied by means of trowels and floats. The interval between the application of primer coat and epoxy mortar shall be approximately 15/30 minutes depending upon the ambient temperature.

Seal coat shall be applied 24 hours after curing and mild roughening of the surface of the mortar.

5. Coverage

The coverage of resin mix would depend on the system of resin used. However, as a general guideline the coverage area shall be as under:

- a) Primer Coat. An area of 3-6 square metres will be covered by 1 kg of resin hardener mix, depending on the finish of the concrete.
- b) Epoxy Mortar. One square metre of surface requires approximately 20-24 kg of epoxy mortar, when laid to a thickness of 10 mm.
- c) Seal Coat. An area of 4 to 6 square metres will be covered by 1 kg depending on the temperature of application.

6. Cleaning and Maintenance of Equipment

Tools and equipment are best cleaned immediately after use since the removal of cured resin is difficult and time consuming. The bulk of resin shall be removed using a scraper and remainder washed away completely using solvents such as toluene, xylene or acetone. Equipment shall always be cleaned before the epoxy hardens. Solvents used for this purpose may be Acetone (flammable), Methyl Ethyl Kethone (flammable), Methyl Chloride (non-flammable). Cured epoxies may be removed using Methylene Chloride

7. Testing

7.1 Resin and Hardener Test

Prior to approval of material, the following tests shall be carried out by the Contractor at site or in an authorised laboratory for each batch of resin and hardener and each combination.

- i) Viscosity test for resin and hardener and the mix: three specimens each.
- ii) Pot life test: three specimens each.
- iii) Bond test: three specimens each.

- iv) Shear test: six specimens each, 3 after 24 hours and the other three after 72 hours of curing.

Subsequent tests shall be carried out as directed by the Engineer. Procedure for tests shall be as below:

i) **Pot Life Test**

- a) 500 gm of resin formulation shall be prepared by thoroughly mixing the resin and hardener / accelerator / catalyst component in proposed proportion in a 1 kg capacity hemispheric porcelain bowl by means of a spatula or any other agitating device and time and the ambient temperature noted.
- b) The resin formulation shall be applied with a clean dry 25 mm size painter's brush, on a clean dry surface such as cement concrete over 150 mm - 200 mm length, starting immediately after mixing the formulation and repeating the operation every five minutes. When it becomes just difficult to spread the resin properly with the brush, the time is noted. The time elapsed since completion of mixing of resin formulation, is taken as its pot life.
- c) One pot life test shall be performed on commencement of work and the same shall be repeated every four hours.
- d) In case the material fails to satisfy the pot life test, it shall not be used for injection.

Where the resin and hardener get mixed at point of injection, the pot life is not important and no tests may be required.

ii) **Bond Test**

A standard 150 mm diameter and 300 mm long concrete cylinder shall be cast in 2 pieces by providing a separating medium at an axis of 45 degrees to the longer axis of the cylinder.

Three such split cylinders shall be prepared. Two pieces of each cylinder shall be joined with epoxy mortar at four points to give a clear gap of about 0.2 mm, which will be injected with epoxy resin at site. After epoxy has been cured, load test shall be carried out on the cylinder. The failure shall not take place at the joint injected with epoxy resin. Also the strength of cylinder at failure shall not be less than 80 percent of the 28 days cube strength of the concrete mix.

iii) **Shear Tests**

Two steel plates, minimum 3 mm thick, shall be bonded with epoxy at site using the same resin mix as used/proposed to be used for injection. The assembly shall be kept in mechanical clamp till epoxy is cured. A total of six specimens shall be prepared for each batch of materials. Three test specimens shall then be

subjected to a shear force along the axis after 24 hours and the minimum shear strength before failure shall not be less than 1 MPa.

The remaining test specimens shall be similarly tested after 72 hours of curing. The shear strength before failure shall not be less than 2.5 MPa.

7.2 Core Test

If directed by the Engineer, cores shall be tested for the acceptance of the work. The selection of the location of cores shall be as directed by the Engineer in such a way that damage in critical/stressed areas of the structure is avoided.

The Contractor shall obtain 50 mm diameter initial core samples in the first 50 linear metres. Thereafter, frequency of core sampling shall be as specified or as agreed by the Engineer. The depth of the core shall normally be less than 200 mm.

Tests and Acceptance Criteria shall be as follows:

- a) Penetration- Visual examination of the core should show epoxy adhesive filling a minimum of 90 percent of the crack.
- b) Bond Strength- When tested for bond, concrete failure should occur before adhesive failure. Also, minimum bond strength of 40 MPa should be developed with no failure of either concrete or adhesive.

If the cores taken in first 50 m length pass tests as specified above, epoxy adhesive injection work at area represented by cores will be accepted.

If cores fail either by lack of penetration or bond strength, work shall not proceed further until the areas represented by the cores are re-injected and re-tested for acceptance.

Filling of Core Holes

Two-component bonding agent shall be applied to surfaces of cored holes followed by filling of non-shrink cement grout mix placed by hand trowel, thoroughly rodded and tamped in place. The surface shall be finished to match the finish and texture of existing concrete to the satisfaction of the Engineer. Materials to be used and procedures for filling core holes shall be got approved by the Engineer before proceeding with work.

7.3 Test for Injection Equipment

At all times during the course of the work, the Contractor shall keep complete and accurate records and make available to the Engineer, the results of the pressure and ratio tests specified below so that the efficacy and accuracy of the injection equipment is verified.

The Engineer at any time may direct the Contractor to conduct additional tests in his presence.

a) Pressure Test

The mixing head of the injection equipment shall be disconnected and the two adhesive component delivery lines shall be attached to the pressure check device, which shall consist of two independent valved nozzles capable of sensing the pressure. The check device shall be closed and equipment operated until the gauge pressure in each line reads 5 MPa. The pumps shall be stopped and the gauge pressure shall not drop below 4 MPa within 2 minutes.

The pressure test shall be run for each injection unit at the beginning and after break of every shift.

b) Ratio Test

The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device, which shall consist of two independent valved nozzles. There shall be a pressure gauge capable of controlling back pressure by opening or closing valved nozzles capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to read 5 bar for both adhesive components, which shall be simultaneously discharged into separate calibrated containers during the same time period. The amounts thus discharged shall be compared to determine whether the volume/discharge conforms to the manufacturer's recommended ratio for applicable material.

8. Personnel and Environment Safety

Any skin contact with epoxy materials, solvents and epoxy strippers should be avoided. Epoxy resins and particularly epoxy hardeners (B component) may cause a rash on the skin. The official toxicity classification on the container labels may be looked at before starting work.

Rubber gloves, with a cloth liner, and protective clothing shall be worn. Barrier creams are recommended but are not substitutes for protective clothing. Eyes shall be protected where splashing could occur while spraying or mixing. Good ventilation shall be ensured and inhalation of vapours avoided. If materials are sprayed, a respirator shall be used.

If contact occurs with the skin, it shall be immediately washed with a cleaner, followed by soap and water. Should eye contact occur, it shall be flushed immediately with plenty of water for 15 minutes and a doctor called for.

If contact occurs with the clothing, it shall be immediately changed to prevent further skin contact, and if the contact occurs with components A or B, the clothing shall be thrown away. Hardened epoxy is not harmful but will break the clothing.

All emptied, used buckets, rags and containers shall be removed from site. These shall be stored in waste disposal bags and suitably disposed of.

9. Measurements For Payment

Measurement for application of epoxy mortar shall be in square metre of surface area of application

10. Rate

The contract unit rate for application of epoxy mortar shall include cost of all materials, labour, tools and plant, placing in position, testing and other incidental expenses including surface preparation for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

Item no. 34

Shear connectors:- Drilling holes into existing concrete substrate for anchoring of new anchoring rebars with 12/16 mm dia shear connectors at 1.5 m c/c as per drawing and for additional rebar provision in repair area and fixing with chemical anchor lokfix of fosroc make / Masterflow 935 of BASF make / Hilti Hy200 / Fischer. Drilling hole diameter: 4 mm larger to rebar dia drilling depth: min 10 times the rebar dia including cleaning, cutting, fabricating, chemical, tools, tackles etc. completed as directed by EIC..

10mm

12mm

16mm

Material:- chemical anchor lokfix E77 of fosroc make / Masterflow 935 of BASF make / Hilti Hy200 / Fischer or equivalent.

a) Masterflow 935 (BASF make):

Masterflow935 is a two-component, thixotropic, pure epoxy resin based chemical anchoring mortar. The product is specially designed for applications where heavy loads under critical conditions are to be fixed in concrete. Both components of Masterflow 935, packed in a single cartridge with separate compartments, are correctly mixed in the mixing nozzle during application.

Advantages: High adhesive power, Fast curing time – saves time and money, Easy to extrude, Styrene free formulation – low odour, High mechanical strengths, Can be used in diamond drilled holes, Applicable in slightly damp conditions, Can be used at high temperatures, Very low shrinkage, even on big diameters, For interior and exterior use, Specially suitable for technical applications, For fixing in solid material like concrete or brickwork.

b) Lokfix P (Fosroc make):

Lokfix are used for high strength corrosion resistant anchoring of bolts and bars from 12 - 51mm diameter into concrete, rock, masonry or brickwork where high speed of installation and early application of load is required.

Advantages: Rapid strength gain, Vibration resistant, Corrosion resistant, Non expansive, Can be placed under water and damp conditions.

Methodology:-

Provision of Additional Reinforcement and Shear Connector

- a) Wherever the reinforcement is reduced by corrosion for more than 20% of its original diameter, extra main steel is to be provided by welding a suitable dia. bar to existing steel or lapping it suitably (lap = 50 times the bar dia.). While doing this it may be necessary to take anchorage in sound concrete in case length beyond damaged portion is not adequate to provide lap and welding is not feasible. In such cases drill a slightly oversize (4 mm more in dia.) hole adjacent to existing main reinforcement, to a depth of 80-150 mm depending upon dia. of rebar and anchor new reinforcement using anchor resin grout of approved manufacturer.
- b) New reinforcement can be clamped on soffit of damaged concrete slabs and anchored into

supporting beams or at the end of the slab by making L-shape bend.

- c) For strengthening of columns and beam by jacketing methodology, new reinforcement shall be provided as per drawing and structural consultant recommendation by rebar grouting for Main steel.

Mode of Measurement & Payment:

Measurement shall be taken in Numbers of shear connector fixed and shall be paid as per rates approved.

Item no. 35

Shuttering: Providing, erecting and removing proper, safe and leak proof shuttering using Plywood, steel plate to facilitate any type of concrete repair work etc. as directed by Engineer in charge.

- Special watertight shuttering/formwork shall be provided for concrete, Micro concrete etc. This shall necessarily require structural stability, retention of form shape and resistance to leakage under hydraulic pressures of water/cement slurry/ concrete/mortar etc.
- The basic material for shuttering /formwork shall be MS sheet and MS structural sections, fasteners and the appropriate joint sealants.
- The shuttering/formwork shall be suitably designed to be able to withstand /resist the assessed hydraulic pressures likely to be exerted.
- Minimum Configuration of the shuttering plates shall however be as under:
 - Steel plate shuttering materials using a minimum 3 mm thick MS sheets welded over a frame of MS Angle iron or T-iron of minimum size 40 x 40 x 5 mm thick.
 - Minimum 10 mm dia. MS bolts and nuts and washers for connecting and tightening joints with suitable resilient packing material to ensure retention of required shape and water tightness for the required pressure.
- The rate includes all required materials, labor, Equipment's, plants formwork, staging etc. required to carry out this item including transporting, launching, shifting, placing in exact position etc. complete as directed by Engineer-in-charge.
- The measurement shall be on the basis of **square meter**.

Item no. 36

Providing and fixing in position fully moulded restrained elastomeric Bearings as per detailed drawings.

- 1 The relevant specifications given in (Para 6.5) **MORT&H specifications as in section 2000** (Pg. No-623) for elastomeric bearing shall apply to this. The bearing pads shall be procured from experienced, renowned, reputed manufactures/suppliers as approved by engineer in charge. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
- 2 The measurement shall be **on cubic centimeter basis**.
4. The rate includes conveying to site all materials, and providing all labor, plants & Equipments, testing, placing in position etc. as required for completing the item.

Item no. 37 Supplying, fitting and fixing in position true to line and level POT-PTFE bearing consisting of a metal piston supported by a disc or unreinforced elastomer confined within a metal cylinder, sealing rings, dust seals, PTFE surface sliding against stainless steel mating surface, complete assembly to be of cast steel/fabricated structural steel, metal and elastomer elements to be as per IRC: 83 part-I & II respectively and other parts conforming to BS: 5400, section 9.1 & 9.2 and clause 2006 of MoRTH Specifications complete as per drawing and approved technical specifications.

MORT&H specification -2006 (Pg. No-648) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on MT basis of work done.

Item no. 38

Painting Two Coats on New Concrete Surfaces (Painting two coats after filling the surface with synthetic enamel paint in all shades on new plastered concrete surfaces)

1. Painting two coats after cleaning the surface with Synthetic enamel paint in all shades on concrete surfaces after thoroughly brushing the surface to remove all dirt & loose powdered material shall be carried out as per direction of Engineer-in-charge.
2. Primer coat and two coats of Synthetic Enamel Paint of approved quality shall be applied on concrete surface area exposed to Atmosphere and in superstructure as per direction of engineer in charge.
3. The measurement shall be in **Square metre**.
4. The rate includes all materials, labor, equipment, plant, transportation etc. to execute this item.

Item no. 39

Painting on Steel Surfaces (Providing and applying two coats of ready mix paint of approved brand on steel surface after thorough cleaning of surface to give an even shade)

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Item no. 40

Steel work, welded In built up sections framed work including cutting, hoisting, fixing in position and applying a priming coat of red lead paint. (A)In beams and joists, channels angles Tees, flats, with connecting plates or angle cleats as in main and cross beams. Hip and jack rafters, purlins connected to common rafters and the like.

MORT&H specification -1900 (Pg. No-615) shall be followed in connection with this item. Allrelevant provisions as have been included in the respective IRC and IS specifications arealso applicable.

Mode of Payment: The payment shall be made on sqm for painting & quintal for steel work basis of work done.

Item no. 41

Road marking with hot applied thermoplastic paints with reflectorizing glass beads on bituminous 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/center line/ edge line/cut patta. The white color marking should provide luminance coefficient on cement road shall be min 130 mcd/m²/lux and Asphalt road shall be min 100 mcd/m²/lux during the service life during the daytime. 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 MORT&H specifications as in section 803.4 (Pg. No-338) (Fifth Revision, April-2013) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
- 2 The rate includes cost of all materials, labor, plants and everything to execute the item.
- 3 The colour width and layout of road makings shall be in accordance with the Code of Practice for Road Markings with thermoplastic paints and as specified in the drawings or as directed by the Engineer-in-Charge.
- 4 The measurement shall be in **sq.m**

Item no. 42

Supplying and fixing cat eye (Stimsonite) made out from Acrilo beaultile sterine injuction high compressed molding with reflector made of MMC (prismatic type of size 12cm x 6cm x 2.5cm) provided with bituminous adhesive 100g. with each unit for fixing. (High Intensity grade)

- 1 Relevant specifications given for above work as described shall be applicable to this item. (MORT&H Specifications Section 801 (Pg. No-325))
- 2 The measurement shall be **per number of Cat eye provided.**
- 3 The rate for this item includes cost of all materials, labor, plants and everything required to execute this item etc. complete and maintain till completion of the work and as directed by engineer in charge.

Item no. 43 Metal Beam Crash Barrier

Type - A, "W" : Metal Beam Crash Barrier (Providing and erecting a "w" metal beam crash barrier comprising 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a spacer of channel section 150 x 75x5 mm, 330 mm long complete as per clause 811)

METAL BEAM CRASH BARRIER

1. This work shall consist of furnishing and erection of metal beam crash barrier of dimensions and at locations as shown on the drawing or as directed by the Engineer.
2. Metal beam crash barrier shall generally be located on approaches to bridge structures, at locations where the embankment height is more than 3 meters and at Horizontal Curves.
3. Railings/crash barrier shall not be constructed until the centering false work for the span has been released and the span is self-supporting.
4. For concrete with steel reinforcement, specifications for the items of controlled concrete and reinforcement mentioned under relevant sections of these specifications shall be applicable.
5. The railing/crash barrier shall be carefully erected true to line and grade posts shall be vertical with a tolerance not exceeding 6mm in 3m. The pockets left for posts shall be filled with non shrink mortar.
6. The type of railing/crash barrier to be constructed shall be as shown on the drawings and shall conform to IRC:6 and IRC:5. 15.4.5. Crash barriers shall provide a smooth and continuous face on the traffic side and shall be suitably extended into the approaches. Exposed rail ends, posts and sharp changes in the geometry of the railings shall be avoided. Suitable reflective (luminous) devices shall be provided on the traffic face of the barrier at intervals to ensure adequate visibility during night and foggy conditions.

7. Care shall be exercised in assembling expansion joints in the railings to ensure that they function properly
8. The bridge railings shall be amenable to quick repairs.

Warrants: The longitudinal roadside barriers are basically meant to shield two types of roadside hazards i.e. embankments and roadside obstacles and also for preventing the vehicles veering off the sharp curves. Therefore, all embankments with height 3 m or more shall have safety barriers at the edge of formation, with delineating reflectors fitted on them.

Normally on shoulder side the lateral distance of at least 0.75 to 1.0 m width from edge of paved portion (i.e. carriageway + paved shoulder) should be available without any obstacles. Wherever a permanent object cannot be removed for some reasons, provision of tandems viz. W-beam metal crash barriers and hazard markers with reflectors must be made. Further, frangible lighting columns and sign posts need to be used for minimizing the severity in case of collision. Irrespective of type of barrier being used, the slope in front of W-beam or wire rope or rigid barrier shall be near to flat gradient so that safety barrier perform best when impacted by a vehicle and the slope of ground in front of barrier shall not be steeper than 10:1.

Some of the commonly encountered roadside obstacles are bridge piers, abutments and railing ends, roadside rock mass, culverts, pipes and headwalls, cut slopes, retaining walls, lighting supports, traffic signs and signal supports, trees and utility poles.

Bridge rail / crash ends, transition end and end treatment.

Traffic crash barrier is warrants. For an approach barrier to a bridge. The criteria for clear zone requirements given in figure:6 shall be apply. The crash barrier shall be provided where transition sanction between approach barrier and bridge railing / barrier. If the end of approach barrier terminate within clear Zone, a crash worthy end treatment is also warranted.

The end of the road side barrier can be hazardous if hit, therefore it should be formed as an integral part of safety barrier end treatment. It should not spear, vault or roll, a vehicle for head on or angled impacts.

The end treatment on approach shall be modified eccentric loader terminal (MELT) as shown in fig.-13 and departure sides shall be trailing terminal (TT) arrangement shown in fig 14.

Placement of crash barrier on road edge barrier.

As far as possible, crash barrier should be placed at a distance of 2.5 m from the carriage way (Travelled way) for long & continuous stretches. The distance between barrier & hazard should not be less than deflection of barrier by an impact of full size vehicle. In case of embankments a minimum distance of 60 cm should be maintained between barrier and start of embankments - slope or hazard to prevent vehicle dropping.

When the kerb exists on the edge of road and on close proximity of travelled way, weather on shoulders or median edge line a distance of 100 mm shall be maintained between vertical face of the kerb & W- beam face. The steel barrier shall be placed in such a way so as not to be collided by vehicle directly fig. - 17.

The material of metal railing/crash barrier shall be handled and stored with care, so that it remains clean and free from damage. Railing/crash barrier materials shall be stored above the ground on platforms, skids, or other supports and kept free from grease, dirt and other contaminants.

Any material which is lost, stolen or damaged after delivery shall be replaced or repaired by the Contractor. Methods of repair shall not damage the material or protective coating.

Metal Railings/Crash barrier

Materials, fabrication, transportation, erection and painting for bridge railings shall conform to the requirements of section 800. All complete steel rail elements, pipe terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised or painted with an approved paint.

If galvanised, all elements of the railing shall be free from abrasions, rough or sharp edges, and not be kinked, twisted or bent. If straightening is necessary, it shall be done by methods approved by the Engineer.

Damaged galvanised surfaces, edges of holes and ends of steel railing cut after galvanising shall be cleaned and re-galvanised.

The railing/crash barrier shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawings, metal railing/crash barrier shall be given one shop coat of paint and three coats of paint after erection if sections are not galvanised.

Railings/crash barrier shall not follow any irregularity in the alignment of the deck. When shown on the drawings, the rail elements shall be curved before erection.

The work shall consist of furnishing and erection of metal safety barrier of dimensions and at locations as shown on the drawing, 'or' as directed by the Engineer-in-charge.

MATERIALS:

Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the plans. Railing posts shall be made of steel of the sections, weight and length as shown on the plans. All complete steel rail elements, terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanized. All elements of the railing shall be free from abrasion rough or sharp edges and shall not be kinked, twisted or bent.

Steel beam elements and terminal sections shall be galvanized (zinc coated, 0.55 kg. Per square meter, minimum single spot) unless otherwise specified. The galvanizing on all other steel parts shall conform to the relevant IS specifications. All fittings (bolts, nuts, washers) shall conform to the IS: 1367 and IS: 1364. All galvanizing shall be done after fabrication.

Concrete for bedding and anchor assembly shall conform to section 1700 of MORTH & H specification for Road and Bridge work (fourth revision) 2001.

Metal beam rail shall be corrugated sheet of galvanized iron of the class, type section and thickness and shall be provided in one row as indicated in the item and shown on plan. Railing post shall be of steel section 150 mm x 75 mm x 5 mm. All complete steel rail elements, terminal sections, bolts, nuts, hardware and other fittings shall be galvanized. All elements of the railing shall be free from abrasion, rough or sharp edges and shall not be kinked twisted or bent, and shall conform to the confirming to IS 2062 IS 1367 and LS 1364.

Baseplate of size 240 x 320 x 16 mm thick of steel grade Fy 250 Mpa confirming to IS 2062. All steel members shall be galvanized with coating thickness not less than 550 gm / m² (gsm) galvanizing shall be as per MORTH specification. Fasteners/ bolts shall be of grade 4.6 and diameter 16mm dome head bolts. W-beam metal crash barrier shall confirm to MORTH specification. MORTH specification for metal crash barrier shall be applicable.

3mm ACM type reflector, 100 mm wide and 4.50 m long, type 4 class-B, High intensity grade sheeting as per IRC 67-2012 including labour.

Anchor bolts shall be of minimum grade 4.6 and manufactured by Hilti or equivalent confirming to IS 1367 and LS 1364 and butt welding shall be applied to all nuts and bolts.

radium red/yellow colour strip of size 100 x 300 mm shall be fixed on vertical front side of post for better night visibility.

CONSTRUCTION OPERATIONS:

The line and grade of railing shall be true that shows on the plans. The railing shall be carefully adjusted prior to fixing in place to ensure proper matching and abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment. Unless otherwise specified on the drawing, railing steel posts and their beam shall be given one shop coat of paint (primer) and three coats of paint on structural steel after

erection. Any part of assembly below ground shall be painted with three coats of red lead paint.

Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

Workmanship

The concrete base shall be cleared with relevant detailed specification.

Base plate shall be fixed with anchor bolts in existing concrete as shown in drawing or as per manufacture guidelines minimum depth of 200mm for solid slab and for T beam girder slab base plate on top and bottom of slab shall be provided.

The Pit shall be back filled with M-300 as shown on drawing or as directed.

While fixing steel post shall be embedded in concrete at 1.5 mt C/C with necessary base plate and anchor bolts using epoxy chemical. The line and grade of railing shall be true to that shown on the plan. The railing shall be carefully adjusted to fixing in place to ensure proper matching at abutting joints and correct alignments and caber throughout their length. Holes for field connection shall be drilled with the railing in place in the structure at proper grade and alignment. Placement / fixing crash barrier in accordance with guidelines specified in IRC 119, 2015.

Railing steel post shall be given one coat of primer and two coats of paint on structural steel after erection if the sections are not galvanized. Any part of assembly below ground shall be painted with two coats of red lead paint.

INSTALLATION POSTS:

Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipments, provided these are erected in proper position and free from distortions and burring or any other damage.

All post holes that are dug or drilled shall be of such size is will permit proper setting of the posts and allow sufficient room for backfilling and topping.

Holes shall be backfilled with selected earth or stable Materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed, when

backfilling and tamping are completed. The posts or anchors shall be held securely in place.

Post holes that are drilled in rock and holes for anchor posts shall be backfilled with concrete.

Posts for metal beam guardrails on bridges shall be bolted to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

ERECTION:

All guardrail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the Engineer.

All bolts or clips used for fastening the guardrail or fittings to the posts shall be drawn up tightly. Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

TOLERANCE:

The posts shall be vertical with a tolerance not exceeding 6 mm in a length of 3 meter. The railing barrier shall be erected true to line and grade.

The relevant specification as per M.O.R.T. & H. Clause - 801, 802 of Section 800 & Section 1900 for fixing and fabrication and other for completed satisfactory work as directed.

MEASUREMENT AND PAYMENT:

Metal beam railing barriers will be measured by linear meter of completed length as per plans and accepted in place. Terminals/ anchors of various types shall be paid for by numbers.

No measurement for payment shall be made for projections or anchors beyond the end posts except as noted above. Furnishing and placing anchor bolts and /or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

Rate

The Contract unit rate shall include full compensation for furnishing of labour, materials, tools, equipments and incidental costs necessary for doing all the work involved in constructing the metal beam railing barrier complete in place in all respects as per these Specifications.

Mode of Payment: The payment shall be made on Rmt. basis of work done.

Item no. 44 Reinforced Cement Concrete Crash Barrier (Provision of an Reinforced cement concrete crash barrier at the edges of the road, approaches to bridge structures and medians, constructed with M-400 grade concrete with TMT Corrosive Reinforcement Steel (CRS) conforming to IRC:21 and dowel bars 25 mm dia, 450 mm long at expansion joints filled with pre-moulded asphalt filler board, keyed to the structure on which it is built and installed as per design given in the enclosure to MOST circular No. RW/NH - 33022/1/94-DO III dated 24 June 1994 as per dimensions in the approved drawing and at locations directed by the Engineer, all as specified).

MORT&H specification -811 (Pg. No-360) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on Running meter basis of work done.

Item no. 45

Hazard Marker Sign :-Providing and fixing sign boards made out of 2.0 mm aluminum sheet/4 mm ACP (Aluminum composite Panel); size 90x30 cms. Rectangular as per design of IRC-67-2012.Pre treated with phosphating process & acid etching coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with Micro Prismatic Grade retro reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications;1.8mtr long stand post of 75 x 75 x 6mm/65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm; painted with best quality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.

- 1 MORT&H specifications as in section 801 (Pg. No-325) (Fifth Revision, April-2013) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.
- 2 The Size , shape & Colour shall be as per item description for all above items.
- 3 The rate includes cost of all materials, labor, plants and everything to execute the item.
- 4 The colour shall be in accordance with the Code of Practice for Road Markings as specified in the drawings/standards.

Rate :

The contract unit rate shall be payment in full for the cost of making the sign board in Number, including all materials, installing it at the site.

Item no. 46

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

- 1 Relevant specifications given for above work as described shall be applicable to this item. (MORT&H Specifications Section 801(Pg. No-325). The Size, shape &Colour shall be as per item description for all above items.
2. The measurement shall be **in number**.
3. The rate for this item includes cost of all materials, labor, plants and everything required to execute this item etc. complete and maintain till completion of the work and as directed by engineer in charge.

Item no. 47

Providing G.I. 100mm diameter waterspouts including necessary iron gratings as per drawings.

1. Material for the water spout shall be as mentioned in the item and shall be got approved from the Engineer-in-charge.
2. Water spout shall be 100 mm internal dia. G.I. grating shall be provided at the entry and shall be fixed in the recess so as to be flush with the road surface. The quality and size of the grating shall be got approved for the Engineer-in-charge. The water spouts shall project at-least 10 cm. outside the concrete and shall be rigidly fixed in it. The grating and C.I. pipes shall be painted with two coats of anticorrosive black bitumen paint.
3. Measurement shall be **per number** of water spout fixed.
4. Unit rate includes cost of all materials, labor and tools to complete the work.

Item no. 48

Lifting of super structure (Girder slab type , Solid slab, Box type or any other) using jacks, power packs, packings and required equipment, tool, plants etc all. The lifting shall be done in such a manner that, proper workmanship for replacement of bearing and pedestals can be achieved. all safety measures for keeping the superstructure safe in lifted position must be ensured. the rate includes lowering the superstructure after completion of repair works for Piercap, Pedestals, Pier etc. The rate shall include all material , labor, jacks, power packs, equipment, DG set for electricity, packings, levelling the surface using structural steel plates etc. all complete as per satisfaction of engineer incharge.

Purpose:

Lifting of existing bridge superstructure is required for the replacement of bearing OR repairing of Girder Bottom Near the Bearing.

Methodology:

1. Calculate the Total Dead load of Super Structure for each span of bridge.
2. After getting reactions for each end, arrange the hydraulic jacks in position on top of pie cap. location/number and size of jacks shall be selected in such a manner so that no undue stresses are created in the structure. Capacity of each hydraulic jack should be 1.5 times the reactions at each location.
3. The system shall have provision for manual override to control the loads of any particular jack. The jacks should be so synchronized that differential lift between individual jacks does not exceed 1 mm.
4. Suitable packing of various depth and packing plates of various thickness to be arranged.
5. Start lifting of span by introducing pressure in Hydraulic jacks. Ensure all the hydraulic jacks shall be operated from one control panel by a single control lever., this would ensure uniform lifting of span at one end.
6. On lifting certain height as decided by Engineer incharge, put wooden / steel packings below Diaphragm / Girder for additional safety incase of failure of Jacks / Power packs. Thus alternative lifting and providing packing plates shall be carried out till required lifting is achieved.
7. On completion of lifting, proper packing shall be ensured at all ends.
8. Once the lifting of required height is achieved, Span shall be kept in same position so that work (Replacement of Bearings or repairing of Pedestals) under lifted Span shall be carried out.
9. After completion of work, slowly release the pressure in all jacks simultaneously and remove packing plates alternatively. Place the super structure span on bearings safely and in accurate position as it was before.
10. Remove all the jacks and packings and move to the next location and repeat the above process.

The lifted superstructure shall be kept in lifted position till the replacement of bearings has been finished. All the debris around the bearings / pedestals / pier caps shall be removed and cleaned. All Safety provisions shall be provided to make the span safe in any condition, and situation.

The rate includes labor, material, Jacks, Power packs, packings, other equipment, supporting arrangement, trestle, its precast footings, etc all , as per requirement.

The mode of payment shall be **“per span”** for which the bearings are to be replaced.

Item no. 49

Providing and laying precast RCC 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

MORT&H specification -410 (Pg. No-143) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on Sqm basis of work done.

Item no. 50

Providing And lying of polymer modified micro concrete like Renderoc RO (L) of Fosroc) / Master emaco S346 / T 288 of BASF / or equivalent material of Krishna Conchem blended with washed saturated surface dry (SSD), graded, low absorption, high density, aggregates of size 5 mm to 12 mm at 50 % by weight of micro concrete and water at 4 lit. per 25 kg bag and pouring into the form work using suitable Arrangement or if required using pumping device for uniform low of micro concrete. The side shuttering can be removed after 3 days and bottom shuttering after 7 days ensuring proper bond between the micro concrete and the existing concrete sub strate. Item rate is inclusive of the materials all labour, supervision, tools and tackles and transportation including shuttering etc. complete as per specification and as directed by EIC. (Considering Avg. Thickness of 75 mm)

1. Scope

This specification covers the **supply and placement of polymer-modified micro concrete** blended with graded aggregates, used for structural repair/strengthening of RCC elements by pouring or pumping into formwork.

2. Materials

A. Micro Concrete Material

- Approved proprietary brand:
 - **Renderoc RG / RO (L)** of Fosroc,
 - **MasterEmaco S346 / T 288** of BASF,
 - **or equivalent** from Krishna Conchem or approved brand.
- Should be **pre-packed**, non-shrink, cementitious micro concrete with **polymer modification** and excellent flowability.

B. Aggregates

- Clean, **graded, low-absorption, high-density natural aggregates**, 5 mm to 12 mm size.
- **Washed and Saturated Surface Dry (SSD)** condition before blending.
- Mixing ratio: **50% by weight of micro concrete material**.

C. Water

- **Potable quality water** shall be used.
- **4 litres per 25 kg** bag of micro concrete (as per manufacturer's datasheet and field condition adjustment).

3. Mixing

- Mixing shall be carried out using a **mechanical mixer** or **drill with paddle**.
- Mix micro concrete powder, water, and aggregates thoroughly to achieve a **homogeneous, lump-free, flowable mix**.
- Avoid over-mixing or introducing excessive air.

4. Placement

- The mixed micro concrete shall be **poured or pumped** into prepared and shuttered sections.
- Ensure **continuous, uniform flow** to prevent cold joints and honeycombing.
- Pouring shall be completed within the **pot life** of the material (~30–45 minutes depending on ambient conditions).
- **Compaction is not required** as material is self-compacting.

5. Formwork and Shuttering

- Formwork shall be **rigid, leakproof**, and coated with **form release agent**.
- Provide **bottom and side shuttering** as required:
 - **Side shutters to be removed after 3 days**.

- **Bottom shutters to be removed after 7 days.**
- Maintain **adequate head pressure** for gravity or pump-fed placement.

6. Surface Preparation

- Existing concrete surface to be thoroughly cleaned using **wire brush, air/water jet**, or equivalent.
- Remove loose materials, laitance, oils, and dust.
- Substrate should be **pre-wetted** to **SSD condition** before application.

7. Bonding and Compatibility

- Ensure proper **mechanical keying and bonding** between the substrate and micro concrete.
- If required, use an **approved bonding agent** (like Nitobond EP or equivalent) as per site condition and manufacturer's instructions.

8. Curing

- Curing to start **immediately after formwork removal**.
- Use **curing compound** or keep surface moist for a minimum of **7 days** to avoid early-age cracking.

9. Coverage & Thickness

- Consider **average thickness of 75 mm**.
- Yield per 25 kg bag (without aggregate): approx. **12.5 – 13 litres**.
- Adjust total quantity based on aggregate addition and thickness required.

10. Measurement & Payment

- Payment shall be made as per **actual quantity** of micro concrete used, considering average thickness of 75 mm and area covered.
- **Unit rate includes:** cost of material (micro concrete, aggregates, water), labour, mixing, pumping/placing, shuttering, surface preparation, curing, and all tools, tackles, transportation, supervision etc., complete.

11. Compliance & Approval

- All materials used shall comply with manufacturer's specifications and relevant **IS standards**.
- Work shall be carried out **as per specification** and **to the satisfaction of Engineer-in-Charge (EIC)**.

Item no. 51

Concrete curing compound

The acrylic emulsion and water based concrete curing Membrane (Such as Concure AB or equivalent) and applying immediately after repair/concrete gets finished. The membrane shall be sprayed over concrete finished are without any gap or pinhole. The cost of all materials, tools and all labour are included. Complete as specified and directed by EIC.

- The curing compound shall be conforming to ASTM-C-309-81, Type-2, white pigmented compound. The solids dissolved in vehicle shall be either class 'A' (no restrictions) or Class 'B' (resin as defined in ASTM D-883) as approved by the Engineer.
- White pigmented compound (Type-2) shall consist of finely divided white pigments as vehicle solids, ready mixed for immediate use without alteration. The compound shall present a uniform white appearance when applied uniformly to a fresh concrete surface at a specified rate of application. It shall be of such consistency that it can be readily applied by spraying to provide uniform coating at temperatures above 40C. If two coats are to be applied then it should be applied at an interval of approximately one hour. They shall adhere to freshly placed concrete that has stiffened or sufficient to resist marking during the application and to damp hardened concrete and shall form a continuous film when applied at a rate of 4 m² / litre. When dry, the covering shall be continuous flexible and without visible breaks or pin holes and shall remain as unbroken film at least 28 days after application. It shall not react deleteriously with the concrete.
- The compound shall meet with the requirement of water retention test as per ASTM designation C-156-80. The loss of water in this test shall be restricted to not more than 0.55 kg/m² of exposed surface in 72 hours.
- The white pigmented compound (type 2) when tested as specified in accordance with method E-97 of ASTM shall exhibit a day light reflectance of not less than 60% of that of magnesium oxide.
- It shall fulfil the requirement of drying time when tested in accordance with ASTM-C-309-81. The compound applied shall be dry to touch in not more than 4 hours. After 12 hours it shall not be tacky or tack off (peel off) concrete when walked upon nor it shall impart a slippery surface.
- The liquid compound should be of a sprayable consistency.

➤ **Acceptance Testing:**

Prior to the approval of the brand / trade name of compound and the source of supply and manufacturer acceptance testing shall be carried out to demonstrate the conformance of the compound to clause 2. In addition, testing shall be performed to demonstrate that no adverse / undesirable change in quality of concrete or concrete surface takes place as a result / by-product of the use of the compound. These tests should be designed to check properties such as loss of strength at 28 days of surface layer, or of concrete cube, change in surface texture, change in

adhesion to subsequently applied layer like plaster, flooring, tiling etc. The type and number of tests are to be as specified by the Engineer.

➤ **Outline Testing:**

- The liquid membrane forming curing compound should be brought in the manufacturer's original clear containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the compound, the type of compound and class of vehicle / solids, the nominal percentage of volatile material and batch or lot number. The lot numbers will be assigned to the quantity of compound mixed, sampled and tested as single product. The manufacturer shall exercise the care in filling the container so that all are equally representative of the compound produced.
- Curing compound to be used on site shall be got tested at least 14 days in advance so that the result of water retention tests, reflectance test, drying etc., are available before it can be permitted for use. All of the filled containers represented by the approved sample shall then be sealed to prevent leakage, substitution or dilution. The Engineer-in-charge or authorized representative should mark each container represented by the samples with a suitable identification mark for later identification and correlation and shall be kept in store with double lock arrangements. One key shall be kept with the Contractor and the other with Engineer. Random samples shall be collected from every batch of the compound. Frequency of random sampling shall be done as directed by the Engineer. The Contractor shall provide samples and labour for collecting samples free of cost. Testing shall be carried out by agency approved by the Engineer and in presence of his representative.

➤ **Method of Application:**

- The compound shall be sprayed using mechanical sprayer of approved design to ensure uniform and continuous membrane on the concrete surface. The coverage shall be at the rate specified by the manufacturer or at the rate of 4 m² per litre or as specified by the manufacturer and approved by the Engineer. Field trials shall be conducted to decide effective coverage rate, which depends upon surface finish. The Engineer after verification of the field trials and based on the actual experience shall order the rate of application as needed for achieving the proper curing. With a view to ensure thorough and complete coverage, approximately one half of the compound for a given areas should be applied by moving the spray gun back and forth in one direction and the remaining half at right angles to this direction. In case the application is still not found uniform, the Contractor shall have to apply the second coat as an when directed by the Engineer. If a second coat is to be applied, it should be applied approximately after an interval of one hour. The curing compound shall generally be applied as soon as the bleeding water or shine disappears, leaving dully appearance. If surface treatment by roughing, hand brushing etc., is required (e.g. as in case

of road pavements) the curing compound should be applied immediately after the same. Equipment for spraying curing compound shall be of pressure tank type (5 to 7 kg/cm²) with provision of continuous agitation. A curing jumbo with multiple travelling spray fans shall be provided for effective spray. Spraying on concrete lining shall be done in such a way that the green concrete is not disturbed or damaged or any foot impression left. Necessary schemes or spraying by mechanized means shall be got approved by the Engineer-in-charge. However, in emergency for very small areas / patches) it can be applied with wire or bristled brush.

➤ **Measurement :**

The contract rate shall be per **square meter** of the area applied.

Item no. 52

Providing and carrying out load test on bridge deck with simulated loading including provision, placing and removal of loading, supplying, fixing and removing deflection measuring instruments etc. complete with platforms for fixing the instruments etc. complete as per the details supplied and specification and as directed by Engineer and including submission of required results in triplicate after satisfactory completion of the load test.

Load testing shall be based on IRC special publication No. 51 for equivalent static Designed live load including impact. This will include providing necessary dial gauges of required least count, a rigid independent staging for dial gauges, a safe and stable independent platform for observers with all necessary ancillaries and thermometers for noting surrounding temperature.

1. Loading and unloading in stages the static load in the form of sand bags (weighed to confirm the actual weight) or P.C. concrete blocks placed on the deck in marked area of required length and breadth as directed by Engineer-in-charge.
2. The payment shall be in M.T. for test load only.
3. If the results of the load test are not satisfactory in the opinion of Engineer in charge, he shall instruct that the part of the structure concern shall be taken down and reconstructed to his satisfaction or that other remedial measures shall be taken to make the structure secure and strong as per requirements at the contractor own risk and cost.
4. The rate for this item shall include cost of all materials labour, machinery, plants gauges, jacks, everything required for conducting the test and submitting reports of the tests.

Item no. 53

Providing & applying CFRP Anchors of high strength carbon fiber RELinforce C Anchor of RIL or equivalent make of 4mm Dia and 200 mm long along with following fiber properties. Tensile strength of fiber >4900 Mpa E Modulus of fiber >230 Gpa Note: For all FRP materials, there has to be a certificate from the supplier for the quantities supplied during bill certification.

➤ **Purpose:**

For anchoring the U-Wraps with the structural member for better performance.

➤ **Materials:**

- CFRP Anchors of 4 mm dia. and 200 mm length with given specifications in item description of RELinforce C Anchor of RIL or equivalent.
- Saturant of RELinforce Fab S or equivalent saturant

➤ **Application methodology:**

1. For Anchoring of the applied FRP strengthening system, The length of the anchors should be as per the design drawings and calculations provided. The starting $\frac{3}{4}$ part the anchor which will go inside the structure with the help of drilled hole, called as anchor dowel component while the remaining end part, which we have to spread on the cure Carbon fiber laminate, called as anchor fan component.
2. For application, drill a hole of appropriate thickness and length through the cured carbon fiber wraps at regular spacing shown in Drawing or Engineer in-charge.
3. Impregnate the whole anchor with **RELinforce** Fab S or equivalent saturant properly and squeeze out the excess amount of saturant.
4. Carefully insert the dowel part of the anchor into the hole very carefully so that there should not be any twisting of fibers during insertion.
5. Spread out the upper Fan part of the anchor in star pattern (in all directions), it will distribute the load in all the directions equally.



CFRP Wraps anchored with CFRP Anchors

➤ **Measurement :**

The measurement of payment shall be **Number of Anchor**.

Item no. 54

Providing & Application of U Wrap till L/4 from the edge of the Girder with 230 GSM Unidirectional Carbon Fiber Reinforce C Fab 230 of Reliance Industries Ltd or equivalent along with fiber anchors with following properties after necessary Surface Preparation & Putty Filling. Aerial Weight: 230 g/m² Tensile Strength (Composite Laminate) : > 450 MPa E-Modulus (Composite Laminate): > 35 Gpa

➤ Features

- (i) System does not create an additional load on the structure,
- (ii) Corrosion resistance,
- (iii) Ability to perform the repair and rehabilitation without interrupting the operation of the buildings/structures,
- (iv) Minimum labor and time to be spent on the work and
- (v) Wide range of applications.

➤ Properties

Table 2 : Physical and Mechanical Properties of Carbon Fiber Fabric 230 GSM

Sr. no.	Properties	Details / Value
1	Fiber Type	High Strength Carbon Fiber
2	Fiber Direction	0°
3	Weaving style	Plain
4	Width	500 mm
5	Wrap	12K/ 24K Carbon Fiber
6	Weft	Glass Fiber (Thermo Fixed)
7	Tensile Strength of Fiber	>4900 MPa
8	Modulus of Elasticity of Fiber	>250 GPa
9	Tensile Strength (Composite Laminate)	>450 MPa
10	Modulus of Elasticity (Composite Laminate)	>35 GPa

➤ Application

- (i) Structural strengthening, repair and rehabilitation of reinforced concrete, masonry, metal (steel) and wooden structures,
- (ii) Increasing the load carrying capacity of reinforced concrete, masonry, metallic and wooden structures(including complex geometric shapes) without increasing their weight and
- (iii) Increased seismic resistance.

➤ Methodology:

- The effectiveness, integrity and performance of the RELinforce C Fab 230 or equivalent depend on the preparation and soundness of the substrate. Therefore, preparing a clean and sound substrate is the most important part of the entire application process. Environmental effects and corrosion of the reinforcing bars can cause damage to concrete or masonry. Any such concrete or masonry area that is determined by the engineer of record or other properly trained personnel to be damaged and unsound must be removed and repaired before application of the RELinforce C Fab 230 or equivalent. Defects in concrete substrate can compromise the strength of the system. Covering of carbonated or chloride-contaminated concrete with RELinforce C Fab 230 or equivalent without addressing the source of contamination will be detrimental to the effectiveness of the repair system.
- All sharp fins, protrusions, surface irregularities and unevenness shall be ground to a smooth surface with less than 1/32 inch in deviation. Surface preparation shall promote continuous intimate contact between the material and concrete by providing a clean and smooth flat or convex surface. Disk grinders or similar equipment may be used to remove paint, stains and other surface substances that may affect the bond. Any surface protrusions caused by crack injection must be removed before application of the RELinforce EP putty or equivalent. For severe undulations and defects use RELinforce EP Mortar or equivalent as per the shared data sheet. The surface must be completely cleaned of any dust, grease, oil, curing compounds, wax, stains, paint, surface lubricants, foreign particles, weathered layers or any other bond inhibiting materials. All corners and

sharp edges shall be rounded or chamfered to a minimum radius of 3/4 inch or greater with an appropriate grinder.

- Once the substrate is thoroughly cleaned properly, use pressurized air blower for removal of dust from the substrate. All surface voids and undulations must be filed before wrapping process using RELinforce EP Putty or equivalent. Such concrete surfaces must be first primed with RELinforce Fab S or equivalent Saturating system prior to the application of the EP putty. RELinforce Fab S or equivalent saturating system must be applied at ambient and surface temperatures or equivalent between 10 °C and 38 °C. RELinforce EP putty or equivalent should be applied as soon as the primer becomes tacky. EP putty will take 3 to 5 hours to cure, curing schedule may vary due to variation in ambient temperature. Once the Putty is cured, initiate the saturant layer application step.
- All resin systems supplied by RELinforce or equivalent are two-component systems, containing a Part A (Resin) and Part B (Hardener). We will be using saturant RELinforce Fab S or equivalent having mixing ratio of 100 Parts Resin to 50 parts Hardener (by weight). It is very important that the two parts are thoroughly mixed in proper recommended proportion for proper development of desired properties. Saturant Fab S or equivalent Part A & Part B must be mixed for a minimum of 3 minutes or until a uniform color and consistency is achieved. No organic solvents or thinners should be used to thin the epoxies. If mixed resin begins to generate heat or display increased viscosity should not be used and discarded properly.
- Epoxy systems generates exotherm during the curing time, mix only small quantities in containers with a large surface area to allow heat dissipation. The longer the epoxy components are left in the container, the more heat they will generate, resulting in hardening and wasting of the epoxy.
- Calculate the quantity of the saturant RELinforce Fab S or equivalent to be mixed as per the provided consumption. Apply the mixed RELinforce Fab S or equivalent system to the substrate with the help of Roller. Let the applied saturant layer become tacky before applying the fabric.
- Once the RELinforce Fab S or equivalent is applied to the substrate, it will become tacky within 10-20 minutes, during this waiting period cut the fabric of required appropriate lengths. The fabrics and laminates provide the necessary strength in the primary direction of their fibers. Therefore, it is paramount that the plies and fibers in the fabric be oriented in the directions that are shown on the construction documents and drawings. The installed fibers must be free of kinks, folds, waviness and misalignments.
- Once the fabric is applied to the substrate with the help of saturant, use hard PVC roller in the longitudinal direction of the fibers to impregnate the fiber with the saturant as well as remove the air bubbles in the lamination process. Repeat this process 2 - 3 times in order to wet the applied Carbon Fiber with the saturant properly without any air voids. The applied CFRP system will cure in 2-3 hours, during this period monitor and correct if there is any disbondment or dislocation of the fabric from the substrate.
- The final coat of RELinforce Fab S or equivalent saturant should then be applied onto the surface of the applied fiber layer once the fibers are firmly adhered to the substrate. The second coat of the saturant should be applied before 24 hours (for better bonding and mechanical properties, we recommend to apply the second layer within first 3 – 6 hours) from the application of the first layer of the saturant. Apply the remaining quantity of the saturant as per the given consumption calculations. The coated surface should be strongly squeezed in the fiber longitudinal direction 2 – 3 times with the help of hard PVC roller to impregnate the fibers.
- **Measurement :**
The measurement of payment shall be in **Sq.mt.**

Item no. 55

Carbon Fiber Laminates for structural strengthening - Providing and applying 5mm thick and 105 mm wide Carbon Fiber Pultruded Laminate strips RELinforce C Lam 105/5 of RIL make or equivalent to the prepared substrate using thixotropic epoxy adhesive. The FRP laminate used shall be of zero degree unidirectional fibres having (1) Volumetric fiber content of >65% (2) Tensile strength of 1500 MPa (3) Tensile modulus of 160 GPa. (4) Compressive strain to failure % shall be 0.8. The thixotropic epoxy bonding adhesive shall be applied at 2-3 mm thickness for adhering the laminate to the substrate. (1) The adhesion of the entire system (Laminate and adhesive combined) with concrete shall be > 1.5 - 2 MPa with concrete failure as per ASTM D 4541. (2) The adhesive used shall have tensile modulus > 4100 Mpa (ASTM D638) (3) Tensile Strength > 50 MPa (ASTM D790). Note : Surface to be rendered using epoxy putty like RELinforce EP Putty of RIL or equivalent make. No site made.

➤ Features

- (i) High mechanical properties,
- (ii) System does not create an additional load on the structure,
- (iii) Corrosion resistance,
- (iv) Ability to perform the repair and rehabilitation without interrupting the operation of the buildings/structures and
- (v) Minimum labor and time to be spent on the work.

➤ Properties

Table 4 : Physical and Mechanical Properties of CFRP Composite Pultruded Plate 1.4mm Thick

Sr. no.	Properties	Details / Value
1	Fiber Type	High Strength Carbon Fiber
2	Fiber Direction	0°
3	Resin	Epoxy
4	Width	100 mm
5	Thickness	1.4 mm
6	Cross Section	140 mm ²
7	Fiber Fraction	0.75 to 0.80
8	Tensile Strength of Fiber	>4900 MPa
9	Modulus of Elasticity of Fiber	>250 Gpa
10	Tensile Strength of Laminate	>2800 MPa
11	Modulus of Elasticity of Laminate	>165 GPa
12	Elongation	>1.8 %

Table 5: Physical and Mechanical Properties of CFRP Composite Pultruded Plate of 5mm Thick

Sr. no.	Properties	Details / Value
1	Fiber Type	High Strength Carbon Fiber
2	Fiber Direction	0°
3	Resin	Polyurethane
4	Width	105 mm
5	Thickness	5 mm
6	Cross Section	525 mm ²
7	Fiber Fraction	>0.65
8	Tensile Strength of Fiber	>4900 MPa
9	Modulus of Elasticity of Fiber	>250 Gpa
10	Tensile Strength of Laminate	>1400 MPa
11	Modulus of Elasticity of Laminate	>150 GPa
12	Flexural Modulus of Laminate	>140 GPa
13	Flexural Strain %	>0.72
14	Transverse Flexural Strength	>50 MPa

15	Interlaminar Shear Strength	>52 MPa
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➤ **Application**

- (i) Structural strengthening, repair and rehabilitation of reinforced concrete, masonry, metal (steel) and wooden structures,
- (ii) Increasing the load carrying capacity of reinforced concrete, masonry, metallic and wooden structures (including complex geometric shapes) without increasing their weight and
- (iii) Increased seismic resistance.

➤ **Methodology:**

1. Chip off loose concrete from bottom of Girder / str. Member using chisel and hammer. Electrically operated chisel (Light duty Mechanical breaker / hammer) may be used. Debris should also be cleared on regular basis and area to be kept clean. The loose concrete behind reinforcement, if any should be carefully removed. Corroded reinforcement should not be bent using chisel in order to create access. Only loose concrete should be taken out. This can be checked by lightly sounding the hammer over chipped area to ascertain any hollow sound on substrate. **(As per relevant item)**
2. Removal of corrosion scales on corroded reinforcement bars should be done manually using sharp tools such as chisel to scrape rust scales from the surface. Thereafter use wire brushes to clean the surface of rebar. Since the brush would not be able to access behind the bars use emery paper to clean exposed surface as well as areas with difficult access. Rotary wire brushes, shaft type rotary wire brushes can be used in place of hand-held brushes. Exposed concrete surface is also to be cleaned with wire brush/rotary wire brush to remove all the loose material, dust, dirt oil etc.
3. Finally clean the exposed area with high pressure water jet of suitable pressure and allow the surface to get dry.
4. All exposed old reinforcement shall be cleaned using rust remover **Reebaklens RR of Fosroc make or Rust clean of BASF or equivalent** and then washed with clean water to remove traces of rust remover and finally allowed to dry. (As per relevant item)
5. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply Two component epoxy-based zinc rich anti-corrosive primer Nitozinc Primer or equivalent material of BASF with the help of brush such that continuous film is formed on rebar and no rebar is left uncoated. **(As per relevant item)**
6. Apply the Bonding agent on exposed surface for proper bonding between Old Surface and New Surface. **(As per relevant item)**
7. Mix and apply Spray Mortar as per manufacturer's mixing & application procedure. The mortar shall be applied in layers of thickness as specified by the manufacturers, by spray equipment. Thickness of layers shall be monitored at site to avoid delamination/collapse. Further layers shall be applied after setting of the previous layer, to attain the desired thickness. Before applying subsequent layer, the surface shall be saturated by water / bonding/ Priming material, as specified by the manufacturer. After applications of mortar the final surface shall be finished using a wooden / steel float. **(As per relevant item)**
8. Grind sharp corners to 35 mm radius. This is to avoid stress concentration.
9. Providing and applying RELinforce Lam A or equivalent product of RELinforce laminate system. It shall be mechanically mixed as per the mixing ratio of 100 Parts Resin to 50 parts Hardener (by weight). Apply the mixed Laminate adhesive as per the provided consumption with the help of steel trowel on the primed surface as well as on the Carbon Laminate also for better performance properties. Press the carbon Laminates against the concrete surface with the hard roller and hold it temporarily till the adhesive becomes tacky to hold the laminates to avoid voids generations and sagging under its own weight. Mix as much adhesive material as can be applied within its pot life. Mixed material exceeding its pot life shall be discarded and not used for application.
10. The carbon fiber laminates to be used shall be RELinforce C Lam PU 105/5 or equivalent as per the design provided. It shall be precision cut using a mechanical cutter in lengths required as per the design drawing. Clean the laminates of all the dust and loose suspended particles. Fix the adhesive applied RELinforce C Lam

PU 105/5 or equivalent against the concrete substrate by gently pressing the same. Roll the laminates with a medium nap roller, pressing along the longitudinal direction to avoid air entrapment and proper embedding of the laminates into the laminate adhesive. Level the excess adhesive that oozes out at the edges of the laminates in a tapered form. Any deviation in alignment of the laminate shall be corrected by straightening the same immediately. Laminates should be suitably anchored as per the design and recommendation.

11. After wrapping Saturant, Cut the Fabric in required appropriate lengths and size. Then, install the Fabric on the prepared surface. The installed fibres must be free from kinks, folds, waviness and misalignment. **(As per relevant item)**
12. Once the fabric is applied to the substrate with the help of saturant, use hard PVC roller in the longitudinal direction of the fibers to impregnate the fiber with the saturant as well as remove the air bubbles in the lamination process. Repeat this process 2-3 times in order to wet the applied Carbon Fiber with the saturant properly without any air voids. **(As per relevant item)**
13. The final coat of saturant should then be applied onto the surface of the applied fiber layer once the fibers are firmly adhered to the surface.
14. The second coat of Saturant should be applied within 24 hours from the application of the first layer of the saturant.
15. The coated surface should be strongly squeezed in the fiber longitudinal direction 2-3 times with the help of hard PVC roller to impregnate the fibers.
16. For application of Anchors, drill a hole of appropriate thickness and length through the cured carbon fiber wraps at regular spacing shown in Drawing or Engineer in-charge.
17. Impregnate the whole anchor with saturant of approved make properly and squeeze out the excess amount of saturant.
18. Carefully insert the dowel part of the anchor into the hole very carefully so that there should not be any twisting of fibers during insertion. **(As per relevant item)**
19. Spread out the upper Fan part of the anchor in star pattern (in all directions), it will distribute the load in all the directions equally.

➤ **Measurement :**

The measurement of payment shall be in **Linear Mt.**

Item no. 56

Carbon Fiber Grids for structural strengthening - Providing and applying High Strength Carbon Fiber Mesh RELinforce C Grid on wet mortar and application of second layer of mortar and float to finish followed by curing. The repair mortar used shall be single component and shall be mixed with water at water powder ratio of 0.18 and shall have drying shrinkage < 1000 micro strain as per ASTM C 157-93; compressive strength > 40 MPa; Flexural Strength > 7 Mpa as per ASTM C 348, bond strength > 6 MPa as per ASTM C 1042. Repair mortar used shall have CE (CE-29842) marking and compliance according to Construction Products Directive 89/106/EEC (CPD). Carbon Fiber Mesh shall have the following properties: (1) Grid size of 15x15 mm (2) Areal weight of 260 g/sqm (3) Tensile strength of 2400 N/mm² (4) Elastic Modulus of >230000 MPa (5) Elongation at break >1.5% (6) Bond strength > 1 MPa as per ASTM D4541 Note : For all FRP materials, there has to be a certificate from the supplier for the quantities supplied during bill certification.

➤ Features

- (i) Can be used for High-Temperature & Moisture laden surfaces being a cementitious sandwiched system.
- (ii) Corrosion resistance,
- (iii) Ability to perform the repair and rehabilitation without interrupting the operation of the buildings/structures.
- (iv) Minimum labor and time to be spent on the work and
- (v) Wide range of applications and non-flammable

➤ Properties

Table 1: Physical and Mechanical Properties of Carbon Fiber Mesh 260 GSM

Sr. no.	Properties	Details / Value
1	Fiber Type	High Strength Carbon Fiber
2	Fiber Direction	0°/ 90°
3	Width	1200 mm
4	Wrap	24K
5	Weft	24K
6	Cell Size	15 mm X 15 mm
7	Tensile Strength of Fiber	>4300 MPa
8	Modulus of Elasticity of Fiber	>230 GPa
9	Tensile Strength (Wrap)	2600 MPa
10	Tensile Strength (Weft)	2100 MPa
11	Elongation at break %	>1.5 %

➤ Application

- (i) Structural strengthening, restoration, reconstruction, repair, seismic retrofitting of reinforced concrete/concrete, masonry, metal (Steel), Wood constructions.
- (ii) Increasing the load capacity of reinforced concrete / concrete, masonry, metallic and wooden structures (including complex geometric shapes, as well as in confined spaces) without increasing their weight.
- (iii) Increased seismic resistance.

➤ Methodology:

1. Remove the concrete cover or upto deteriorated concrete using light hammer or chisel. The loose concrete behind reinforcement, if any should be carefully removed. Remove the dust and dirt from that area and make surface clean. **(As per relevant item)**
2. Removal of corrosion scales on corroded reinforcement bars should be done manually using sharp tools such as chisel to scrape rust scales from the surface. Thereafter use wire brushes to clean the surface of rebar. Since the brush would not be able to access behind the bars use emery paper to clean exposed surface as well as areas with difficult access.
3. Finally clean the exposed area with high pressure water jet of suitable pressure and allow the surface to get dry.
4. All exposed old reinforcement shall be cleaned using rust remover Reebakleens RR of Fosroc make or Rust clean of BASF or equivalent and then washed with clean water to remove traces of rust remover and finally allowed to dry. **(As per relevant item)**
5. Apply bonding agent on exposed surface area for proper bonding of old surface and new surface. **(As per**

relevant item)

6. Provide one layer of Rendroc SP40 or equivalent shrinkage compensated fiber reinforced polymer modified wet spray repair mortar of thickness of 50 mm on prepared surface. **(As per relevant item)**
7. Now, place in position Carbon fibre grid of given specifications mentioned in item description on the 1st layer wet spray repair mortar.
8. Then, apply 2nd layer of Rendroc SP40 or equivalent shrinkage compensated fiber reinforced polymer modified wet spray repair mortar of thickness of 50 mm on CFRP grid layer. **(As per relevant item)**
9. At last, curing shall be carried out as per instruction of engineer in-charge.

➤ **Measurement :**

The measurement of payment shall be in **Sq. mt.**

Item no. 57

Providing and applying Renderoc SP-40 or equivalent shrinkage compensated fiber reinforced polymer modified wet spray repair mortar on the prepared surface at thickness of 50mm and curing with curing compound. The repair mortar used shall be single component and shall be mixed with water at water powder ratio of 0.18. The cured product shall have following properties: (1) Drying shrinkage < 1000 micro strain as per ASTM C 157- 93 (2) Compressive strength > 20 Mpa at 1 Day 40 MPa at 28 Days as per BS1881 (3) Flexural Strength > 7 Mpa at 28 days as per ASTM C 348 (4) Bond strength > 6 MPa as per ASTM C 1042, etc complete. (5) Tensile strength > 2.5 MPa at 28 days as per BS6319 (5) Fire Rating - Class A1 (EN1504-3) (5) Product used shall have CE (CE-29842) marking and compliance according to Construction Products Directive 89/106/EEC (CPD)

➤ **Features**

- (i) Cost effective
- (ii) Enhanced durability
- (iii) User friendly
- (iv) Definable performance

➤ **Purpose :**

For restoration/repairs of the damaged portions of RCC structural elements wherever directed by the Engineer's representative.

➤ **Materials and T&P :**

➤ **Material :**

Pre-packed spray mortar, a ready to use cement based single component shotcrete mortar. Renderoc SP40, SHOTPATCH 10 of BASF, Sika Repair SHB of Sika or equivalent

➤ **Tools, Plant & Equipments :**

- a. Preparation equipment: Wire Brush, proprietary blasting equipment
- b. Mixing equipment, horizontal Pump and vertical Pumps
- c. Wooden/steel/Plastic floats etc. all other.

➤ **Procedure:**

1. Chip off loose concrete from bottom of Girder / str. Member using chisel and hammer. Electrically operated chisel (Light duty Mechanical breaker / hammer) may be used. Debris should also be cleared on regular basis and area to be kept clean. The loose concrete behind reinforcement, if any should be carefully removed. Corroded reinforcement should not be bent using chisel in order to create access. Only loose concrete should be taken out. This can be checked by lightly sounding the hammer over chipped area to ascertain any hollow sound on substrate. **(As per relevant item)**
2. Finally clean the exposed area with high pressure water jet of suitable pressure and allow the surface to get dry.
3. All exposed old reinforcement shall be cleaned using rust remover Reebaklens RR of Fosroc make or Rust clean of BASF or equivalent and then washed with clean water to remove traces of rust remover and finally allowed to dry. (As per relevant item)
4. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply two component epoxy-based zinc rich anti-corrosive primer Nitozinc Primer or equivalent material of BASF with the help of brush such that continuous film is formed on rebar and no rebar is left uncoated. (As per relevant item)
5. Apply the Bonding agent on exposed surface for proper bonding between Old Surface and New Surface. (As per relevant item)
6. **Mixer :** Repair mortar must be mixed in forced-action type mixers, and not in free-fall mixers.
7. **Hoses :** The hoses for conveying the mortar should be pressure rated to at least twice the pressure capability of the Pump. Care must be taken to ensure all the hose fittings are properly attached to the hose and are in

good condition.

8. **Application :** Exposed steel reinforcements must be firmly secured to avoid movement during application since it might affect mortar compaction, build & bond strength. The nozzle must be held at 20-50 cm from the substrate for maximum efficiency during wet spray application and to prevent rebound loss or bond failures. Under good conditions, the mortar can be applied at a rate up to 20 liters at a rate upto 20 liters per minute.
9. **Finishing :** Wet spray repair mortar is finished by striking off with a straight edge and closing with a steel/plastic float. Damp sponges or plastic floats may be used to achieve a desired surface texture, but care should again be taken not to overwork the surface.
10. Curing shall be carried out as per standard practice.

➤ **Measurement :**

The measurement of payment shall be in **Sq. mt.**

Item no. 58

Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specifications

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Item no. 59

Providing and laying Filter material underneath pitching in slopes complete as per drawing and technical specification

MORT&H specification -2504 (Pg. No-709) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS specifications are also applicable.

Mode of Payment: The payment shall be made on cum basis of work done.

Item no. 60

Providing and laying - Fitter Media 600mm thick directed at the back of abutments, returns and wing walls as per detailed specifications.

1. Well graded pebbled or metal of 40 mm. to 63 mm. 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	63 mm. to 40 mm.	90 mm.	100-00
		63 mm	85-100
		50 mm.	35-70
		40 mm.	00-15
		20 mm.	00-05

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

2. Materials shall be first stacked in boxed of 2 m. x 1.5m. x 0.5m. size on fairly level ground and measured.

3. The measurement for payment shall be made on Sqm basis of boxes. No deduction shall be made for voids.

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

2504.2.2 Filter Medium

The material for the filter shall consist of coarse sand, gravel or stone. One or more layers of graded materials, to act as a filter medium, shall be provided underneath the pitching, to prevent loss of the embankment material and build up of uplift head on the pitching.

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

$$\frac{D_{15} \text{ of Filter}}{D_{85} \text{ of Base Material}} < 5$$

$$4 > \frac{D_{15} \text{ of Filter}}{D_{15} \text{ of Base Material}} < 20$$

$$\frac{D_{50} \text{ of Filter Material}}{D_{50} \text{ of Base Material}} < 25$$

Notes :

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

2. In the foregoing, D15 means the size of that sieve which allows 15 percent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85 (15 being replaced with 50 and 85 respectively).

3. If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.

4. The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 600 mm.

Mode of Payment: The payment shall be made on Sqm basis of work done.