Gujarat University

TECHNICAL SPECIFICATIONS

RENOVATION AND RETROFITTING WORK

Tender No: GU/ESTATE/STAFF QUARTERS/2016-17/01

Tender Document
For

Renovation work for staff quarters
at Gujarat University.

ANNEXURE 1

DETAIL SPECIFICATIONS & REPAIR METHODOLOGY

Specification of all items are given hereunder, Contractor has to follow the specification as applicable in particular building and items.

Removing damaged concrete:
Removal of existing gunniting work, loose cover concrete including loose damaged concrete from all structural members up to beyond the corroded steel reinforcements to a depth of 10 mm minimum behind the reinforcement only at affected concrete (Good & sound concrete should not be chipped/ damaged) by chipping/hacking with chisel and hammer or by mechanical means like chisel hammer, pneumatic chippers and removal and disposal of debris at designated location within distance of 2 km including labour, tools, scaffolding, electricity, plant and machineries etc. complete as directed by Engg.in charge. Depth of chipping may vary from 50 to 150 mm

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, from the concrete elements, such as columns, beams, external walls as per requirement for internal walls, 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 form 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.

d. Finally clean the area with high pressure water jet of suitable pressure and allow to surface dry.

TYPICAL IMAGE OF SURFACE PREPARED RCC MEMBER

Mode of Measurement & Payment:

a. 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.

Rust Removal

Cleaning of rust / scales/ corrosion from reinforcement bars should be carried out using rust remover, Reebakleens RR of Fosroc. The material 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 labour, tools, scaffolding, electricity, plant and machineries complete as per detail specification and as directed by Engineer-in-charge.

Corrosion protection of existing (OLD) reinforcement is very necessary in order to carryout 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 gratvity of 1.16 - 1.22 @ 25^0C 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.

Mode of Measurement & Payment:

a. 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.

Anti Corrosive treatment to Steel:

Providing & applying inhibition coats/system to exposed reinforcement bars & also new bars, after cleaning & removing scales and rust completely as specified in item no 3, Two component inhibitor MasterEmaco P130 of BASF or equivalent product 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:**
   Concressive ZR (BASF) or equivalent having properties as per BS 4652, Type 2 having with zinc content > 84% by weight, volume solids of 57±3% and a mixed density of 2.4±0.1kg/litre Adhesive bond strength > 1.5 N/mm2, 40 microns DFT
   Concressive ZR of BASF, 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 50% and DFT of more than 50 Microns

Methodology: -

b. After application of rust remover, on dry reinforcement to have an additional barrier against corrosion, apply zinc rich epoxy coating using Concressive ZR (BASF) 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:

a. 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.

Rebarring Main steel :

Drilling holes of min 4mm larger than new rebar diamater into existing concrete substrate for anchoring of new rebars and depth 10 times the diameter of rebar and fixing with pure epoxy resin based cartridge form chemical anchor material Masterflow 935 of BASF or approved equivalent product confirming to NF P 18-831 and NF P 18-836 including cleaning, cutting, fabricating, chemicals, tools, labour, plants, machineries, scaffolding etc. complete as directed by Engineer-in-charge.

Rebarring Shear Connectors :

Drilling holes into existing concrete structure for anchoring of new rebars with 10 mm dia shear connectors at 0.5 mtr c/c and fixing with pure epoxy resin based cartridge form chemical anchor material Masterflow 935 of BASF or approved equivalent product as per NF P 18-831 and NF P 18-836. Drilling hole diameter: 14 mm, Drilling hole depth: 100 mm including cleaning, cutting,

fabricating, chemicals, tools, plants, machineries, labour, electricity, etc. complete as directed by Engineer-in-charge.

Material: -

a) Masterflow 935 (BASF make) or approved equivalent product as per NF P 18-831 and NF P 18-836

Masterflow® 935 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

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. Stirrups and shear connector as per Item no. 5 & 6 above.

Mode of Measurement & Payment:

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

Injection Grouting-Microfine Cement :

Providing and fixing Injection ports/nozzles in staggered manner on all sides of Member at @ 0.75-1.0m c/c spacing 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 40 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, labour, 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) Master Seal 505 of BASF orRenderoc 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.

Properties:

a) **I**nitial set time: Approx. 1 - 2 mins. at 30^0C
(Note: Set times will be extended when mixed or applied at lower temperatures.)

b) Compressive strength : 25N/mm^2 @ 28 days @ 30^0C

d) Klick Nixon make injection grout pump or equivalent.

Methodology: -

Treatment for Honeycombed Areas in Slab, Pier, And Beams, Leakage Spots In Slabs and Making Concrete Dense etc.

In case it is noticed that the beams, columns or slab 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 bridge's 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 0.75 to 1.0 Mt distance in all area. The depth of the drilled hole should be about 200 mm. (in case of slabs, walls 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. The preparation done as above should be allowed to cure for 24 hours.
d. 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.

e. Use 140 PSI grade Killick Nixon make injection grout pump or equivalent.

f. 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.

g. 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:

Measurement and payment of this item will be on the basis of Kg of Microfine cement consumed for grouting

Epoxy Injection Grouting

Providing and executing injection/pressure grouting in cracks in the parent concrete by fixing PVC perforated nozzles at 150 mm to 200 mm distance or specified distances as per design and detailed specifications. Pressure grouting using low viscous epoxy grout Concressive 1315 of BASF or approved equivalent product having mix density 1050 kg/m3, Compressive Strength (ASTM D695)-65 N/mm2,Tensile Strength (ASTM C 304-97)-18 N/mm2,Flexural strength(BS 6319 Part 4)-55 N/mm2 IN 7 Days Pressure grouting shall be done at required pressure including all materials, chemicals, machineries, tools, plants, labours, electricity, scaffoldings, curing etc. complete as directed by Engineer-in-charge.

Material: -

a) Epoxy grout Concresive 1315 of (BASF make) or approved equivalent product having having mix density 1050 kg/m3, Compressive Strength (ASTM D695)-65 N/mm2,Tensile Strength(ASTM C 304-97)-18 N/mm2,Flexural strength(BS 6319 Part 4)-55 N/mm2 IN 7 Days

b) Concressive 2200 (BASF): -
Concresive 2200 is a thixotropic, solvent free, three component compound based on epoxy resins, graded fillers and thixotropic agents. It is applied directly to concrete for filling cracks, blow holes etc., which cures to a surface ready for subsequent coatings.

Methodology: -

Injection grouting for strengthening columns, wall, beams and slabs

For cracks caused by structural distress such as shear cracks, flexural cracks, tensile cracks should be injected with low viscosity epoxy resin. The properties of injection resin desired are as follows:

a. First of all use chisel and hammer to widen the cracks on the surface to about 15 mm wide and 15 mm deep. Then holes of about 13 mm dia. are to be drilled along the cracks. The depth of the drilled hole should be about 200 mm. (In case of slabs , walls and domes the drilled hole depth to be 40-60 % of the element thickness). Use compressed air to clean the hole, as well as crack to remove dust and dirt. Then a 12 mm dia. Special injection nipple is to be fixed into the hole. Spacing of the holes should be about 150-200 mm. Seal the surface around the nipple with Epoxy putty of approved manufacturer like Concressive 2200 (BASF) or equivalent. Also seal the surface of the crack with epoxy putty. This would ensure that the injected grout does not leak from the gaps and from crack surface.

b. The preparation done as above should be allowed to cure for 24 hours.

c. Prepare the injection resin very low viscosity epoxy resin based grout Concressive 1315 or BASF by mixing Resin and Hardener in proportion recommended by the manufacturer. Only small quantities are to be mixed at a time. Use a stirrer or a steel rod to stir the mixture thoroughly.

d. Use Special injection guns with pressure gauge and valves for controlling flow of compressed air and resin. Pressure for injection should be 2-3 kg/cm2.

e. 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 resin 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 resin flows in spite of maintaining the maximum pressure for 3-5 minutes). In such a situation proceed to the next nipple.

f. After completing the injection allow it to cure for 24 hours. Then remove the nozzles and seal the holes with epoxy putty.

Mode of Measurement & Payment:

a) Payment for injection will be done on the basis of Kg of Injection Resin consumed. And shall be paid as per approved rates.

Galvanic Sacrificial Protection of steel:

Providing and fixing sacrificial zinc anode to prevent initialization of corrosion of reinforcement due to chloride ingress from Di-casted VECTOR Galvashield XPI or equivalent at Min. 1 to 2 anodes / Sq.mt. area of concrete (spacing of 300 to 600mm), covered with mortar with of resistivity less than of parent concrete on the cleaned reinforcement steel as per manufacturers specification before applying passivation coating and including of all materials, all labour, supervision, tools, plants, machineries, electricity, scaffolding etc. complete as directed by Engineer-in-charge.

In order to address the inhibition of corrosion in Rebar which are embedded in good concrete but concrete is with some chloride / carbonation and to avoid the incipient anode formation called Hallo effect special treatment is required to have durable repair.
This new type of technology using sacrificial zinc anodes shall be installed at periphery of patch repair or in grid pattern in the repair if chloride content is high in repair area and entire chloride affected concrete is not removed.

These Di casted zinc anodes of **Galvashield XPI or equivalent as per ,**

A. ACI/ICRI 2008 Concrete Repair Manual
B. ACI Guideline No. 222 – Corrosion of Metals in Concrete
C. ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion

when installed at required spacing in range of 350 to 750mm C/c distance depending upon the steel density and concrete area and other parameters shall protect the rebar inside concrete from aggravated corrosion by self-corroding of zinc encapsulated in specially formulated High alkali mortar.
Special care to be taken for installation related to continuity of rebar, connection of rebar with anodes and covering the anodes using low resistivity mortar.

Material: - These Di casted zinc anodes of **Galvashield XPI or equivalent as per ,**

A. ACI/ICRI 2008 Concrete Repair Manual

B. ACI Guideline No. 222 – Corrosion of Metals in Concrete
C. ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion

Mode of Measurement & Payment:

a. Galvashield XPI installed in Numbers shall be measured and payment shall be made in Numbers as per rates approved.

DETAIL SPECIFICATION FOR EMBEDDED GALVANIC ANODES

PART 1 GENERAL

1.01 **Summary**

A. This Section includes furnishing all labor, tools, materials, equipment and services necessary to properly install embedded galvanic anodes.
B. Embedded galvanic anodes are designed to provide localized corrosion protection. When placed at the appropriate spacing along the perimeter of concrete patches or along the interface between new/existing concrete, the anodes mitigate the formation of new corrosion sites in the existing concrete in adjacent areas.

1.02 References

A. ACI/ICRI 2008 Concrete Repair Manual
B. ACI Guideline No. 222 – Corrosion of Metals in Concrete
C. ICRI Guideline 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete resulting from Reinforcing Steel Corrosion
D. ASTM A615/A615M-09 Standard Specification for Deformed and Plain Billet-Steel Bar for Concrete Reinforcement
E. ASTM B6-09 - Standard Specification for Zinc
F. ASTM A82-07 Specification for Plain Steel Wire for Concrete Reinforcement

PART 2 PRODUCTS

2.01 Materials

A. Embedded galvanic anodes shall be pre-manufactured with the following nominal dimensions, 35mm X 80mm X 40mm, and consist of a minimum of 55 grams of zinc (in compliance with ASTM B418, type II,) cast around a pair of uncoated, non galvanized steel tie wires and encased in a highly alkaline cementitious shell with a pH of 14 or greater. The cementitious shell shall contain no added sulfate nor shall it contain chloride, bromide or other constituents that are corrosive to reinforcing steel. Anode units shall be supplied with integral un spliced wires with loop ties for directly tying to the reinforcing steel. Embedded galvanic anodes shall be Galvashield® XPI available from Vector Corrosion Technologies (www.vector-corrosion.com) USA (813) 830-7566, Canada (204) 489-6300, or approved equal.

Application for equals to include:

1. A highly alkaline cementitious shell with a pH of 14 or greater
2. Provide a minimum of 10 years' service life (in similar environment)
3. Contain no added constituent's corrosive to reinforcing steel or detrimental to concrete, e.g. chloride, bromide, sulfates, etc.

4. Anode units shall be supplied with solid zinc (ASTM B6 Special High Grade) core cast around integral uncoated steel tie wires for tying to the reinforcing steel
5. Anode units shall be supplied with integral unspliced tie wires such that the zinc anode is connected to the reinforcement with a continuous, unspliced wire

B. Repair mortars, concrete and bonding agents shall be Portland cement-based materials with suitable electrical conductivity less than 15,000 ohm-cm. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate shall not be permitted. Anodes used with higher resistance repair materials shall be embedded in Galvashield Embedding Mortar to create a conductive bridge to the substrate prior to repair material installation.

C. Deformed bars for reinforcement shall be hot-rolled steel in accordance with ASTM A615/A615M, Grade 60 (Grade 400).

D. Deliver, store, and handle all materials in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 Concrete Removal

A. Remove loose or delaminated concrete.
B. Undercut all exposed reinforcing by removing concrete from the full circumference of the steel as per ICRI R310.1R. The minimum clearance between the concrete substrate and reinforcing steel shall be ¾ inch (19 mm) or ¼ inch (6 mm) larger than the top size aggregate in the repair material, whichever is greater.
C. Concrete removal shall continue along the reinforcing steel until there are no visible signs of corrosion as per ICRI R310.1R.

3.02 Cleaning and Repair of Reinforcing Steel

A. Clean exposed reinforcing steel of rust, mortar, etc. to provide sufficient electrical connection and mechanical bond.
B. If significant reduction in the cross section of the reinforcing steel has occurred, replace or install supplemental reinforcement as directed by the engineer.
C. Secure loose reinforcing steel by tying tightly to other bars with steel tie wire.

3.03 Edge and Surface Conditioning of Concrete

A. Concrete patches shall be square or rectangular in shape with squared corners.
B. Saw cut the patch boundary ½ inch (13 mm) deep or less if required to avoid cutting reinforcing steel.
C. Create a clean, sound substrate by removing bond-inhibiting materials from the concrete substrate by high pressure water blasting or abrasive blasting.

3.04 Galvanic Anode Installation

h. Install anode units and repair material immediately following preparation and cleaning of the steel reinforcement.
i. Galvanic anodes shall be installed along the perimeter of the repair or interface at a spacing as specified on the drawings. Anode spacing will vary with changes in the reinforcing steel density, the level of chloride in the structure and the corrosivity of the local environment, etc.

j. Provide sufficient clearance between anodes and substrate to allow repair material to encase anode.

k. Secure the galvanic anodes as close as possible to the patch edge using the anode tie wires. The tie wires shall be wrapped around the cleaned reinforcing steel and twisted tight to allow little or no free movement.

   a. If less than 1 inch (25 mm) of concrete cover is expected, place anode beside or beneath the bar and secure to clean reinforcing steel.
   b. If sufficient concrete cover exists, the anode may be placed along a single bar or at the intersection between two bars and secured to each clean bar.

l. If repair materials with resistivity greater than 15,000 ohm-cm are to be used or the resistivity is unknown, create a conductive grout bridge between the anode and the substrate. Pack Galvashield Embedding Mortar to cover minimum area of 4 in (100mm) in diameter between the anode and the substrate concrete ensuring no voids exist.

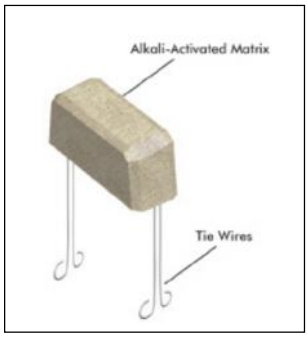
m. Electrical Continuity
   a. Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm,Ω) or potential (mV) with a multi-meter.
   b. Electrical connection is acceptable if the DC resistance measured with multi-meter is less than 1 Ω or the DC potential is less than 1 mV.
   c. Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established with steel tie wire.
   d. Electrical continuity between test areas is acceptable if the DC resistance measured with multi-meter is less than 1 Ω or the potential is less than 1 mV.

3.05 Concrete or Mortar Replacement

A. Pre-wet the concrete surface and the anode units to achieve a saturated surface dry condition, and then complete the repair. Do not soak the anode units for greater than 20 minutes.

B. Repair materials with significant polymer modification and/or silica fume content may have high resistivity. Similarly, if bonding agents are used, they shall have suitable conductivity. Insulating materials such as epoxy bonding agents shall not be used unless otherwise called for in the design.

C. Following normal concrete repair procedures complete the repair with the repair material, taking care not to create any air voids around the anode.



Spray Applied Mortar-70 mm thick & Spray Applied Mortar- 125mm thick:

Providing and applying Pre-packed, cement based , spray applied mortar/microconcrete of min. M40 grade ie minimum of 15 MPa at 1 day and 40 MPa at 28 days like MasterEmaco S 810 of BASF or equivalent product having Drying shrinkage as per ASTM -C-157, EN:126:17Part-4 , crack resistance should be tested as per Coutinho Ring test should pass for Drying shrinkage, Premixed with PAN (poly Acryl Nitrile fibre) on damaged portion of slab /pier to the prepared concrete area, after cleaning the prepared surface with air and water jetting, initially by using spray gun for reporfiling and finally finishing the same with trowel carefully compacting the same around the rebars and finishing to bring it in line with existing concrete surface on the slabs sides and pier including all materials, chemicals, machineries, tools, plants, labour, electricity, curing, scaffolding etc. complete as directed by Engineer-in-charge.

Material: -

1) Master Emaco S810 (BASF) equivalent product having Drying shrinkage as per ASTM -C-157, EN:126:17Part-4 , crack resistance should be tested as per Coutinho Ring test shuold pass for Drying shrinkage, Premixed with PAN (poly Acryl Nitrile fibre)

Properties

1) Compressive Strength @ 28 days : 40 N/mm^2
2) Maximum granular Size : 5mm
3) Density Dry Bulk : 1700 Kg/m^3

Tools & Plant:

a. Mechanical Mortar Spray Equipment with nozzle gun
b. Compressor to blow air or air mixed with water
c. Other necessary tools etc.

Methodology: -Sprayed applied Mortar

Step-1: Testing of Material: Spray Mortar shall be tested for conformance to the specified requirements of 7 and 28-day cube crushing strength, surface absorption of water, permissible limits of shrinkage, etc before use on the work. The Spray Mortar shall be tested for compressive strength from each supply received if any sample from the same batch of manufacture is not previously tested.
Step-2: Surface Preparation: Cleaning of lightly sticking materials and foreign matter from the exposed concrete surface and steel reinforcement by suitable means shall be done.
Step-3: Clean the dust and saturate the prepared surface of concrete and reinforcement with a clean oil free air blast and water.
Step-4: 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.
Step-5: Moist cure the finished surface after the setting of the mortar.

Measurement :
The measurement of payment shall be in Sq. Mt.

Polymer Modified Mortar (Pre-Packed):

Providing and Applying single component, dual shrinkage-compensated, high strength, fibre reinforced, thixotropic cementitious patch repair mortar that achieves compressive strength minimum of 15 MPa at 1 day and 45 MPa at 28 days and capable of applying upto 50mm thick in single layer such as Master Emaco S 348 of BASF make or equivalent product passing (Coutinho Ring test shuold pass for Drying shrinkage), high strength,PAN (poly Acryl Nitrile), to the prepared concrete area FOR AVERAGE THICKNESS OF 60MM, after applying bonding coat (bonding coat shall be included in this item) before the epoxy bonding agent becomes tack free, initially by hand and finally finishing the same with trowel carefully compacting the same around the rebar and finishing to bring it in line with existing concrete surface on the slabs, beam, piles etc., where the thickness of application is less than 75 mm in patches as per specification . Item rate is inclusive of materials all labour, tools and tackles, scaffolding and transportation etc. complete as per specification and as directed by Engg.-in-charge.

Material: -

a) MasterEmaco S 348 (BASF) or equivalent product passing (Coutinho Ring test shuold pass for Drying shrinkage), high strength,PAN (poly Acryl Nitrile) : -

Methodology: -
Repairing Damaged Portion with Repair Mortar

Repair mortar is to be applied over damaged patches of Pier, Wall, beams, slab soffits etc. using Pre Packed Polymer Modified Fiber Reinforced Mortar for thickness of repair upto 50mm.

a) The repairs in the area where thickness of repair is less than 50mm than that area are to be repaired using pre-packed polymer modified fibre reinforced cementitious mortar like Emaco S348 of BASF .
b) This will be applied by trowel and finished smooth without excessive finishing. In one application up to 50 mm of thickness is to be built up. Subsequent layers to be done with one bond coat of cement slurry.

Mode of Measurement & Payment:
Surface area prepared for carrying out repair or treatment shall be measured in sq.mt for payment for thickness of average 60mm and shall be paid as per rates approved.

Structural strengthening of columns/beams by CFRP laminates:

Providing and applying precured carbon fiber laminates carbon fibre based system MBrace Laminate 165/2500, (1.4 mm thick and 100mm wide) or equivalent Nitowrap CFP (laminates) system with compatible structural adhesive including, Surface preparation: Grinding concrete substrate, cleaning it with wire brush removing oil, laitance if present, etc. complete. Profiling: Applying and Filling the holes and uneven surface with epoxy putty etc. complete. Application of plate: Marking the application area on structural element, cutting the plate to require size, applying epoxy adhesive on plate, paste the laminate on desire area by using tamping roller to avoid any air voids etc. complete. Sand pasting: Applying second coat of primer, rectify air voids if any paste the river sand on it to make surface rough to take any further finishes.

CONCEPT OF FIBER WRAPPING CONFINEMENT IN INCREASING THE EFFECTIVE GRADE OF CONCRETE

This is a relatively new technique. It has been first introduced on large scale commercial scale in Japan, Europe and America in the early nineties. It makes use of various high strength fibers such as Carbon, Glass and Aramid oriented and woven in a specific pattern and impregnating these with an epoxy binder. The composites made thus are applied in wet layup method where the composite is first impregnated with epoxy binder and applied over the concrete members such as beams, columns, slabs etc. Alternately epoxy is applied over the members and then dry cloth is wrapped over these and impregnation is done by pressing and rolling the fabric.

Advantages of Fiber Reinforced Composites

This method is relatively easy for application. It does not involve shuttering, reinforcement or mesh fixing, welding, fabrication etc. It has a very high strength to weight ratio. The fiber composites are much lighter than steel and much stronger. The fiber composites are corrosion resistant. The fiber essentially do not undergo any corrosion. The binder resin such as epoxy is also highly resistant to corrosion. These composites not only resist their own deterioration, but also prevent further deterioration of the substrate concrete because of the corrosion resistant barrier they create. The composites have a high degree of tailorability

Confining Action of Fiber Composites In Axial Compression

Tensile strength of concrete is negligible in comparison to its compressive strength. Even compression members often fail due to tensile stress that develops in perpendicular direction. Confinement increases strength and other properties. The confining action of the wrap is created through passive restraint of transverse dilation of concrete under uni-axial compression. The confinement in the form of externally applied fiber reinforced composite jacket places the concrete under state of hydrostatic or tri-axial compression.

In case of columns the wrap is applied in vertical direction to get additional bending capacity and circumferential direction to get confinement and increase in axial load capacity. In case of beams the span moment capacity is increased by applying the fiber on tension face and enhancement in shear as well as preventing slip failure of tension fibers by providing U wraps in shear zones.

Material: -

1. Concressive 2200 of BASF: -

   is a thixotropic, solvent free, three component compound based on epoxy resins, graded fillers and thixotropic agents. It is applied directly to concrete for filling cracks, blow holes etc., which cures to a surface ready for subsequent coatings.

Methodology: -

a. Grind the surface to get an even surface. All projections are to be grounded off.
b. Grind sharp corners to 35 mm radius. This is to avoid stress concentration.
c. Apply epoxy primer like Mbrace Primer or equivalent of Nitowrap laminates system to the prepared concrete surface.
d. Apply Concressive 2200 of BASF or equivalent Nitowarpe laminate system on concave areas. The concavity can lead to air trapping inside and lack of full contact.
e. Providing and applying Mbrace adhesive or equivalent product of Nitowarp laminate system.
f. Pasting of Mbrace laminate 100 X 1.4mm or equivalent product of Nitowarp laminate system.

Mode of Measurement & Payment:

For Laminates: Running meter of laminates installed shall be measured for payment as per approved rates.

IMPROTANT NOTE:

DESIGN OF COMPOSITE STRENGTHENING USING CARBON / GLASS FIBRE WRAPPING AND LAMINATES SHALL BE IN SCOPE OF CONTRACTOR AND WORK TO BE CARRIED OUT AS PER APPROVED DESIGN BY COMPETENT PERSONNEL No extra payment shall be made for Designing and approval and cost of same shall be included in relative items.

PICTORIAL REPRESENTATION OF APPLICATION OF CFRP LAMINATES.

	
Surface Preparation using Grinder & Putty to remove irregularities.	**Application of Adhesive for Laminate.**
	
Installation and Rolling / Pressing of CFRP Laminate.	**COMPLETED CFRP LAMINATES INSTALLATION.**

Additional TMT Steel:

Providing & placing in position TMT bar reinforcement including cutting, bending, hooking and tying complete for solid slab as per detailed drawing or as directed by engineer-in-charge.

Purpose:-Providing additional reinforcement to the existing RCC Structure for the reinforcement lost due to corrosion or providing reinforcement in new RCC members and for Jacketting of Pier.

Materials and T&P: -HYSD reinforcement of minimum 415 grade, conforming to IS 1786 , Galvanized / PVC coated binding wire, welding machine, generator and other incidental tools etc.

Procedure:

Step 1: The additional reinforcement shall be provided as directed by the Engineer's Representative.

Step 2: While carrying out the repairs to the existing RCC members, new rebar shall be fixed to the shear / rebar connectors (already driven into the concrete) by welding. The new rebar shall also be welded with the old rebar. In case, welding is not feasible, binding wire will be permitted, at the discretion of the Engineer's Representative. The new rebar shall be secured rigidly so that the vibration resulting from the deposition of repair material shall not impair or displace them. Minimum requirement of lap length of bars and Minimum cover to the reinforcement shall be as specified in I.S. 456.

Step 3: The rebar shall be provided for new RCC members as per the direction of the Engineer's representative.

Measurement:
The measurement of payment shall be in Kg for Payment.

Water Proof Shuttering :
Providing & fixing and removing leak proof Shuttering of Plywood Or Steel for micro concrete at all levels with necessary supporting system to keep the plywood/Steel shuttering in position during polymer concrete/Micro concrete.Rate includes all material,labour for fixing,removing and keeping in position till the setting of polymer concrete/Micro concrete & removing the shuttering.

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:
a) 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
b) 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.