

SPECIFICATION FOR CONCRETE PATCH REPAIR

Bahagian Forensik (Struktur dan Jambatan)
Cawangan Kejuruteraan Awam, Struktur dan Jambatan
Ibu Pejabat JKR Malaysia
Kuala Lumpur

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SPECIFICATION FOR CONCRETE PATCH REPAIR

1. General

1.1. Scope

- i. The works shall include the removal of concrete on beam, slab and column. The S.O. shall inspect the concrete to identify any cracks, spalls, delaminations or corroding reinforcement. Remedial works for the reinforced concrete shall be determined by the S.O. after his inspection.
- ii. The works shall include the inspection of the concrete by the S.O. and repair as deemed necessary.

1.2. Submissions - Repair Mortar

The Contractor shall submit for the S.O.'s approval:

- i. Name and generic type of the proposed repair mortar material and associated cementitious bond coat for concrete.
- ii. Name and address of supplier and manufacturer of the repair mortar and associated bond coat.
- iii. Product data sheets showing compliance with the specification requirements as per Section 2.0 of this specification. The S.O. will require documentation from an approved independent testing authority to confirm the performance criteria stated on product data sheets.
- iv. Detailed proposal of concrete removal, application and curing techniques to be used.
- v. For site mixed cementitious mortar the following additional information is required:
 - a) Name, type and manufacturer of the proposed cement.
 - b) Name, type and supplier of the proposed aggregates.

1.3. Submissions - Steel Reinforcement

The Contractor shall submit details as per Clause 3.3. of this specification.

1.4. Submissions - Cement Based Reinforcement Primer

The Contractor shall submit details as per Clause 3.5. of this specification.

2. Materials

- i. The repair mortar shall be an approved polymer modified cementitious repair mortar supplied in pre-measured units of dry components and an acrylic or SBR based mix liquid.
- ii. The cementitious bond coat for concrete shall be supplied by the manufacturer of the acrylic or SBR polymer modifier, and the manufacturer shall confirm the bond coat is compatible with the repair mortar.
- iii. Bond coat product approval will normally be given on the recommendation of the manufacturer of the approved proprietary repair mortar or of the approved polymer modified additive to the repair mortar.
- iv. The steel reinforcement and cement based steel reinforcement primer shall both be in accordance with the respective material properties given in Section 3.5 of this specification.

2.1. Prepackaged Mortar

The mortar shall have the following properties, determined in general accordance with ASTM C109, ASTM C490 and BS 1887: Part 208.

2.1.1. Normal Weight Mortars

- i. Compressive strength in excess of 45 MPa at 28 days.
- ii. Flexural strength in excess of 8 MPa at 28 days.
- iii. Drying shrinkage of less than 375 microstrain after 7 days exposure to 50% RH and 23 °C conditions after mixing.
- iv. ISAT water absorption value not exceeding 0.1 ml/m²/sec at 2 hours.
- v. Adhesion strength such that failure is 100% in the substrate or is not less than 1.0 MPa at 28 days.

2.1.2. Lightweight Mortars

- i. Compressive strength in excess of 20 MPa at 28 days.
- ii. Flexural strength in excess of 3 MPa at 28 days.
- iii. Drying shrinkage of less than 375 microstrain after 7 days exposure to 50% RH and 23 °C conditions after mixing.
- iv. ISAT water absorption value not exceeding 0.1 ml/m²/sec at 2 hours.
- v. Adhesion strength such that failure is 100% in the substrate or is not less than 1.0 MPa at 28 days.

Lightweight mortars shall not be used in areas likely to be subject to impact or abrasion damage.

2.2. Storage Of Materials

- i. Materials shall remain in their original sealed containers until the time of use and shall be stored in strict accordance with the manufacturer's specification.
- ii. Each consignment of materials shall be accompanied by a manufacturer's certificate of date of manufacture. Materials stored beyond the manufacturer's recommended shelf life shall not be used.

3. Workmanship

3.1. Removal Of Concrete - Delaminations, Spalls, And Reinforcement Corrosion

3.1.1. Identification And Marking Out

- i. The areas of concrete to be broken out is identified as having:
 - a) Spalled and delaminated concrete.
 - b) Corroded reinforcement. The normal criterion will be areas where the electrochemical potential of the reinforcement is less than -150 millivolts Cu/CuSO₄.

The areas to be inspected by the S.O. will be:

- a) The soffit of beams
 - b) Below all areas of running water e.g. kitchen, toilet, etc.
 - c) Areas of mold growth.
 - d) Other areas deemed necessary for inspection by the S.O.
- ii. The Contractor shall provide all necessary access for the S.O.'s inspection.
 - iii. The concrete to be broken out will be marked out by the S.O. The breakout area shall be entered into record sheets in duplicate and signed by the S.O. The original shall be kept by the S.O. and the duplicate by the Contractor and shall be used as a record for the purpose of measuring the work. Breakout work shall not proceed until approval of the S.O. is obtained.

3.1.2. Extent And Depth Of Concrete Breakout

- i. The perimeter of the repair shall be delineated by cutting at 90 degrees to the surface with a grinding disk so as to avoid feather edges.

- ii. The depth of cut shall be 10 mm. Care shall be taken to ensure that no steel reinforcement is cut e.g. by use of a cover meter. The Contractor shall inform the S.O immediately any reinforcement is cut and the S.O. shall issue instructions for the Contractor to repair the reinforcement at the Contractor's own cost.

3.1.3. Breaking Out Concrete

- i. The Contractor shall submit propping details for the structural elements requiring concrete breakout to the S.O. for approval, signed by a Malaysian P.E. The Contractor shall not commence any concrete breakout until he receives the S.O.'s written approval of propping procedures. The Contractor shall remain responsible for all propping procedures irrespective of the S.O.'s approval.
- ii. Concrete within marked out areas shall be removed using light mechanical breakers or hammer and chisel, cutting to expose the reinforcement and a sound concrete substrate to the satisfaction of the S.O., without breaking out behind the reinforcement.

3.1.4. Additional Concrete Breakout

- i. Where the breakout indicates that the exposed reinforcement is further corroded or the surrounding concrete is not sound, the S.O. shall be informed and an enlarged area agreed to the satisfaction of the S.O.
- ii. The S.O. shall test the concrete for depth of carbonation at the reinforcement depth. The depth of breakout can be increased by the written instruction of the S.O., in clearly defined areas, to remove all carbonated concrete. The additional concrete breakout shall not extend to more than 15 mm behind the bottom layer main reinforcement. During breakout, all care shall be taken to minimise damage to existing reinforcement.
- iii. The Contractor shall mark out the enlarged breakout area for the S.O.'s approval. Upon approval, the additional breakout area shall be entered into record sheets in duplicate and signed by the S.O. The original shall be kept by the S.O. and the duplicate by the Contractor and shall be used as a record for the purpose of measuring the work. Breakout work shall not proceed until approval of the S.O. is obtained.
- iv. Where necessary, fresh saw cuts shall be made to eliminate feather edges at the completion of the breakout.

3.2. Steel Reinforcement Surface Preparation

All exposed reinforcement surfaces shall be thoroughly cleaned to second quality in accordance with BS 4232: 1967, or to the satisfaction of the S.O.

3.3. Additional Or Replacement Steel Reinforcement

- i. The Contractor shall report to the S.O. any reinforcement which has lost 10% or more of its cross sectional area as a result of corrosion. Additional or replacement reinforcement shall be as instructed by the S.O.
- ii. The Contractor shall report to the S.O. any reinforcement which has been damaged by the work. The Contractor shall follow the S.O.'s instructions or means to remedy such damage.
- iii. Replacement reinforcement shall be cleaned to the same standard as existing steel.
- iv. Replacement bars shall be lapped on the side of the existing bars and spot welded on one side. The reinforcement shall be fixed at each end and along its length at suitable intervals to prevent sag.
- v. The Contractor shall submit welding procedures and obtain the S.O.'s consent before commencing such work.
- vi. The Contractor shall obtain the S.O.'s approval of the steel reinforcement prior to proceeding with repair mortar application.

3.4. Concrete Surface Preparation

- i. Smooth off form concrete surfaces shall be roughened by mechanical scabbling to the S.O.'s satisfaction, to provide a good adhesion surface for application of the repair mortar. Care shall be taken to ensure that vibration from the method of preparation does not cause delamination of adjacent render or concrete.
- ii. All concrete surfaces that are to receive repair mortar shall be prepared by mechanical scabbling to remove loose render, surface laitance, organic contaminants e.g. moss, algal growth, etc and other contaminants. Care shall be taken to ensure that vibration from the method of preparation does not cause delamination of adjacent render or concrete.
- iii. On completion of all mechanical preparation, adjacent areas of render shall be tapped with a lightweight hammer or more preferably a 25 mm ball bearing on a 1m long flexing handle. If a delamination is not detected at a crack, the crack shall be filled with a putty filler as per the protective coating surface preparation. Any hollow sounding areas shall be brought to the attention of the S.O.
- iv. Water moistening of the concrete shall be carried out by the Contractor in accordance with Clause 3.6(a) of this specification.

3.5. Cement Based Reinforcement Primer

- i. The reinforcing steel shall be prepared in accordance with Clause 3.2 and be in a dry, clean condition before application of the primer.
- ii. The materials shall be mixed in strict accordance with the manufacturer's specifications.

- iii. The primer shall be applied and cured in strict accordance with the manufacturer's specifications.

3.6. Cementitious Bond Coat For Concrete And Repair Mortar

- i. The concrete surface to which the bond coat is to be applied shall be wet down by soaking with potable water to achieve a moisture condition such that the concrete will not absorb moisture from the repair mortar. The wetting period will depend upon the substrate condition and the bond coat manufacturer's recommendations, and to the S.O.'s satisfaction. The surface shall then be left until the free water has evaporated before the bond coat is applied. The bond coat shall be applied by brush and worked into exposed concrete surface and painted onto the reinforcement. The subsequent repair material shall be applied while the bond coat is still wet or tacky.
- ii. If the bond coat dries before the application of the repair material, the concrete surface shall be scabbled to remove the old bond coat and all rebar coatings inspected and touched up, prior to re-application of the bond coat. This work shall be at the Contractor's own cost.
- iii. The bond coat shall be applied to the newly applied repair mortar surface prior to the application of successive repair mortar layers, in accordance with the manufacturer's recommendations and sub-clause items (a) and (b) above.

3.7. Repair Mortar Patching

3.7.1. Method Of Placing

- i. The repair mortar shall be applied to a surface prepared in accordance with Clause 3.4 and while the bond coat applied in accordance with Clause 3.6 is still tacky.
- ii. The repair mortar shall be mixed using equipment of a type approved by the S.O. and shall normally be a force action mixer. The mixing liquid shall be added to the dry components and thoroughly mixed to achieve a uniform consistency, unless otherwise approved by the S.O. (e.g. site batching, which will require dry mixing the cement and sand to a uniform consistency, then addition of the gauging liquid containing water plus any approved additive).
- iii. The mortar shall then be applied to the bonding agent using hand packing and trowel to the satisfaction of the S.O.
- iv. The textured finish of the final repair mortar layer shall match the finish on the existing interior surface.

3.7.2. Thickness Of Repair Mortar Layers

- i. The repair mortar application shall be built up to the original surface profile in layers not exceeding 16 mm and the final layer shall not exceed 11 mm, in

accordance with BS 5262: 1976, unless as otherwise recommended by the manufacturer and approved by the S.O.

The S.O. may approve repair mortar application thickness up to 20 mm for normal weight and 50 mm for lightweight mortars provided the repair mortar manufacturer can give technical data to support a layer thickness greater than 16 mm. No sagging of the repair mortar shall occur.

- ii. Prior to cure the surface of the repair mortar shall be scarified to provide a key for the next layer.
- iii. Each layer shall be allowed to cure for a period of at least 18 hours, unless otherwise stated by the manufacturer and approved by the S.O., before subsequent layers are applied.

3.7.3. Curing

- i. Curing of the repair mortar shall be in accordance with the polymer modified additive manufacturer's instructions. Where curing agents are specified by the manufacturer, they shall be applied immediately after the surfaces have been scarified for the next repair mortar layer or trowelled to a finish. The application of the curing agent or other curing methods shall be to the satisfaction of the S.O.
- ii. It must be ensured that all curing methods are compatible with the proposed subsequent application e.g. repair mortar or protective coating system. Where doubt exists, non-contaminating curing systems e.g. water soaked hessian and polythene wrap shall be used.

3.8. Repair Mortar Application - Quality Control Testing

- i. Routine quality control tests and inspection shall be performed by the Contractor in accordance with his approved Quality Control and Testing programme. Approval of a repair mortar area by the S.O. will require acceptable results from a visual survey to check for cracking, delamination checking testing and adhesion bond strength tests.
- ii. The Contractor shall inform the S.O. of all completed repair mortar areas one (1) day after final application for the S.O.'s inspection and approval.
- iii. The S.O. shall inspect all repaired areas approximately seven (7) days after final application for cracks by visual observation and delaminations by tapping with a lightweight hammer or a 25 mm ball bearing on a 1m long flexing handle. If a crack or delamination is detected by the S.O. then the Contractor shall breakout the repaired area and repeat the repair mortar application at his own cost.
- iv. The bond strength of the applied mortar to the substrate, and any repair mortar inter-coat layers, will be tested by the S.O. approximately seven (7) days after final application using a Limpet pull off tester, at the minimum rate of 3 per 100 mm² of applied area or 1 per 10 patch repair areas, whichever is the greater number of tests. The Contractor shall carry out site trials on the applied render to establish the 7 to 28 days adhesion strength relationship, to the satisfaction of the S.O., to

enable testing at 7 days to achieve the specified 1 MPa at 28 days. The Contractor shall provide access as required for testing and shall repair any damage to the repair mortar and concrete resulting from the pull off tests, at his own cost.

- v. The bond adhesion strength of the applied repair mortar shall be greater than the tensile strength of the substrate as determined by the failure occurring 100% in the substrate or a minimum value of 1.0 MPa. Where the adhesion strength test does not occur 100% in the substrate nor is greater than 1.0 MPa, additional tests will be ordered by the S.O.
- vi. Areas where bond adhesion strength is found to be deficient shall be removed and replaced as instructed by the S.O. at the Contractor's own cost.
- vii. Upon approval that no cracks nor delamination nor deficient adhesion bond areas exist in the repair area, the location and result of the crack, delamination and bond checks shall be entered into record sheets in duplicate and signed by the S.O. The original shall be kept by the S.O. and the duplicate by the Contractor and shall be used as a record for the purpose of approving the work.