

Part 1 General

1.1 SUMMARY

- .1 The care that is exercised during the removal and preparation phases of concrete repairs can be the most important factor in determining the longevity of the repair, regardless of the material or technique used. This Section covers the removal of deteriorated concrete and surface preparation for the repair of deteriorated concrete resulting from reinforcing steel corrosion and is applicable to horizontal, vertical, and overhead repairs.
- .2 All delaminated or deteriorated concrete must be removed down to sound concrete. The reinforcing may have to be exposed at these locations by removing additional concrete, if there is any sign of corrosion. All concrete and exposed reinforcing shall be cleaned of all corrosion by mechanical means.

1.2 RELATED SECTIONS

- .1 Section 03 20 00 – Concrete Reinforcing.
- .2 Section 03 91 11 – Top Surface Repairs with Rapid Setting Mortar
- .3 Section 03 91 20 – Top Surface Scaling Repairs
- .4 Section 03 93 10 – Hand Patching
- .5 Section 03 93 20 – Pressure Grouting
- .6 Section 03 93 30 – Form and Pour

1.3 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 ACI 546-04, Concrete Repair Guide.
 - .2 ACI RAP-5, Surface Repair Using Form-and-Pump Techniques.
 - .3 ACI RAP-7, Spall Repair of Horizontal Concrete Surfaces.
 - .4 ACI RAP-3, Spall Repair by Low-Pressure Spraying.
 - .5 ACI RAP-4, Surface Repair Using Form-and-Pour Techniques.
 - .6 ACI RAP-6, Vertical and Overhead Spall Repair by Hand Application.
 - .7 ACI RAP-9, Spall Repair by the Preplaced Aggregate Method.
- .2 Canadian Standards Association (CSA)
 - .1 CSA- S448.1-10, Repair of Reinforced Concrete in Buildings.
- .3 International Concrete Repair Institute (ICRI)
 - .1 ICRI concrete Repair Terminology (2010 Edition).

- .2 ICRI Guideline No. 120.1–2009, Guidelines and Recommendations for Safety in the Concrete Repair Industry.
- .3 ICRI Guideline No. 130.1R–2009, Guide for Methods of Measurement and Contract Types for Concrete Repair Work (formerly No. 03735).
- .4 ICRI Guideline No. 310.1R–2008, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion (formerly No. 03730).
- .5 ICRI Guideline No. 310.2–1997, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays (formerly No. 03732).

1.4 MEASUREMENT PROCEDURES

- .1 Prior to construction, concrete repair areas will be identified on-site via soundings completed by the Contract Administrator in the presence of and with the assistance of the Contractor. The areas will then be marked and agreed upon by the Contractor and Contract Administrator prior to commencement of work.
- .2 All costs associated with concrete repair and restoration required to satisfy the intent of the Drawings and Specifications must be included in the Bidders lump sum price.

1.5 DEFINITIONS

- .1 Delamination: A separation along a plane parallel to a surface as in the separation of a coating from a substrate or the layers of a coating from each other, or in the case of a concrete slab, a horizontal splitting, cracking, or separation of a slab in a plane roughly parallel to, and generally near, the upper surface.
- .2 Laitance: A weak layer of cement and aggregate fines on a concrete surface that is usually caused by an overwet mixture, overworking the mixture or excessive finishing, underwater concrete placement, or combinations thereof.
- .3 Sounding: A technique to evaluate the condition of hardened concrete by striking the surface with a hammer; sound concrete will exhibit a clear ringing sound, whereas dull or hollow sounds indicate delaminated areas.
- .4 Spall: A fragment, usually in the shape of a flake, detached from a larger mass by a blow, by the action of weather, by pressure, or by expansion within the larger mass; a small spall involves a roughly circular depression not greater than 120 mm in depth and 150 mm in any dimension; a large spall, may be roughly circular or oval or in some cases elongated, is more than 20 mm in depth and 150 mm in greatest dimension
- .5 Substrate: The layer immediately under a layer of different material to which it is typically bonded; an existing concrete surface that receives an overlay, partial-depth repair, protective coating, or some other maintenance or repair procedure.
- .6 Surface Preparation: The process whereby a method or combination of methods is used to remove deteriorated or contaminated concrete and roughen and clean a substrate to enhance bond of a repair material or protective coating.

- .7 Surface Profile: The topographic contour of the exposed surface of a material or substrate.

1.6 QUALITY ASSURANCE

- .1 Contractor Qualifications:
 - .1 Minimum of 5 years experience in the repair and restoration of concrete structures.
 - .2 Provide minimum 5 examples of local projects demonstrating successful performance concrete repairs of similar size and complexity to specified Work within the last 3 years.
 - .3 Site Superintendent to have a minimum of 5 years experience exhibiting successful performance in concrete restoration projects. Provide references upon request.
 - .4 Ensure all personnel involved with concrete restoration are adequately trained and familiar with the requirements of this Section.
- .2 Field Mock-ups:
 - .1 Upon request, complete a field mock-up for each type of repair. Locations to be site determined.
 - .2 Field mock-up shall be a minimum of 2 sq.ft. and incorporate all aspects of the concrete surface preparation described in this Section. Trial repairs areas shall be chosen to include exposure of embedded reinforcing steel.
 - .3 Field mock-up areas shall be used as a standard against which subsequent work shall be judged.

Part 2 Products

2.1 EQUIPMENT

- .1 Electric or pneumatic chipping hammers are to be used for demolition within the following limits:
 - .1 Initial bulk removal of delaminated concrete above corroded reinforcing steel: maximum 25 lb. electric or pneumatic chipping hammers.
 - .2 Final removal and undercutting of reinforcing steel: maximum 15 lb. electric chipping hammers.
 - .3 Bulk removal of full depth repairs: electric or pneumatic jack hammers with weight ratings above 30 lbs. may be used upon approval by Contract Administrator.
 - .4 Chisel-type blades are to be used for removal only. Do not use pointed chisels for removal.
- .2 Sandblast equipment shall consist of:
 - .1 Air compressor of sufficient capacity to drive the equipment and blast media selected.

- .2 Blast media hopper (meters the media into the air stream passing through the hose and nozzle).
 - .3 Moisture and oil separators to insure clean, dry air supply.
 - .4 Blast nozzle and hose.
 - .5 Materials. The blast medium consistent with equipment, site conditions, and capable of obtaining specified surface profile.
- .3 High pressure waterblast: capable of maintaining a sustained pressure of not less than 4,000 psi.

Part 3 Execution

3.1 EXAMINATION

- .1 The location number and extent of repairs shown on Drawings are indicative only. Repairs areas will be identified on-site by the Contract Administrator in the presence of and with the assistance of the Contractor. The approximately periphery of the repair will be marked on the surface of the member and the location and extent recorded on drawings
- .2 Allow time in the Schedule for survey and inspection work carried out by the Contract Administrator ahead of repairs. Provide sufficient safe access to enable review of all areas designated for repairs.
- .3 The Contractor shall make available as required throughout the Contract labour to carry out the following under the direction of Contract Administrator:
 - .1 Identification of repairs.
 - .2 Sample chipping and/or drilling.
 - .3 Operators for access equipment.
- .4 The Contractor shall make available as required throughout the Contract equipment for the use of the Contract Administrator:
 - .1 Marking paint and chalk.
 - .2 Hammer and chain for sounding surveys.
 - .3 Tape measure.

3.2 PREPARATION

- .1 All necessary measures shall be taken to provide protection to the general public, occupants of the building.
- .2 Remove or protect all surface attachments (e.g. signs, notices, electrical fittings) from the areas to be repaired or from positions that obstruct access or which may be damaged from Work.
- .3 Carefully store items removed during the course of the works. Reinstall when restoration work is complete.

- .4 The Contractor shall make good or rectify any damage caused as a result of insufficient protection.
- .5 Provide temporary access required to facilitate Work.

3.3 CONCRETE DELAMINATION REMOVAL

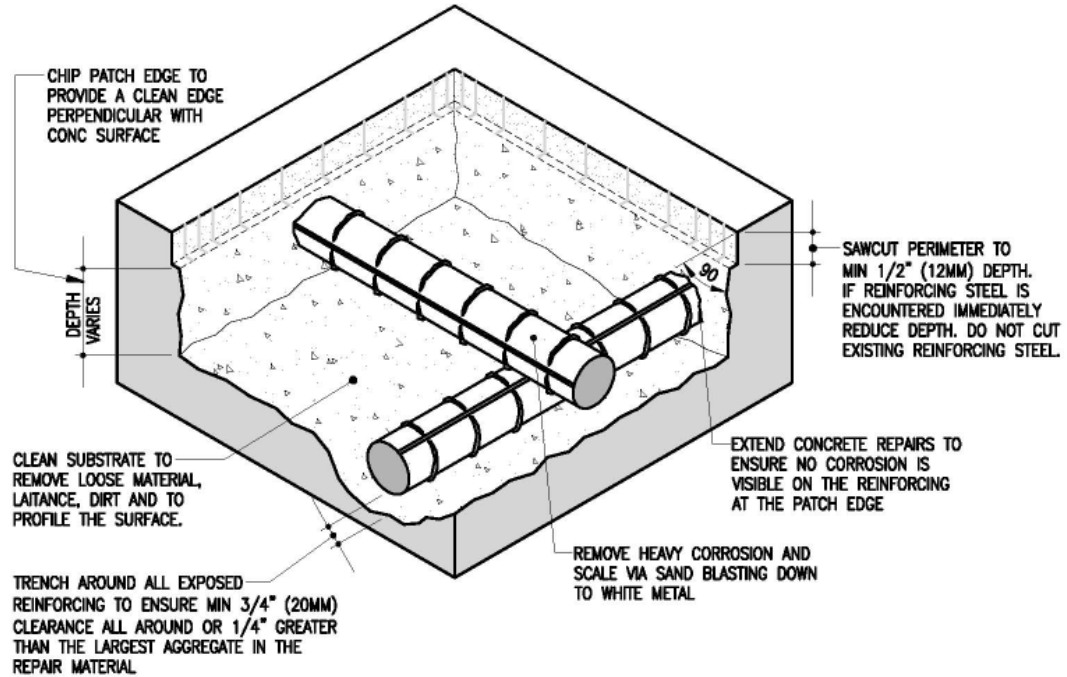
- .1 Refer also to Figure 1 in this Section.
- .2 Remove all loose and or delaminated concrete above corroded reinforcing steel.
- .3 Do not operate hammers or mechanical chipping tools at an angle in excess of 45° measured from the surface of the slab.
- .4 Use chipping to extend concrete removal along reinforcing bars and ensure bars are completely free of corrosion and well bonded to the surrounding concrete. Notify Contract Administrator of increases in areas.
- .5 Where the bond between existing concrete and reinforcing steel or mesh has been destroyed (either by the concrete's deterioration or corrosion of the reinforcing steel) or if the chipping operation has caused more than 1/3 the periphery of a bar to be exposed for a distance of 6 inches (150 mm) or more, the concrete adjacent to the bar shall be removed by maximum 15 lb. electric chipping hammers to provide sufficient clearance between the reinforcement and concrete.
 - .1 Provide a minimum 3/4 inches (20 mm) clearance, or 1/4 inch (6 mm) larger than the largest aggregate in the repair material, whichever is greater.
- .6 If non-corroded reinforcing steel is exposed, do not damage the bar's bond to the surrounding concrete. If bond between the bar and concrete is destroyed, exposing the bar will be required.
- .7 The perimeter of the areas marked as delaminated are to be saw cut to a depth of 1/2 inch (12 mm). Feather edging is not permitted. If reinforcing steel is encountered, the saw depth must be immediately reduced as required. Check depth of the cut regularly.
- .8 Ensure sawcut encompasses the boundaries of corrosion that have been established.
- .9 Ensure the entire area within the saw cut is removed to a depth consistent with the type of repair and repair material specified in other Sections.
- .10 Chip patch edges to provide a clean vertical edge along the patch perimeter to the required minimum depth.
- .11 Conduct soundings to determine if any further unsound or delaminated concrete is present, which must be removed.
- .12 After all delaminated, unsound, or loose material is removed, the Contractor shall request an inspection from the Contract Administrator. This inspection is to be completed in the presence of the Contractor and if any further Work is required, the Contractor is to

complete it immediately. The purpose of this inspection is to provide assurance to the Contract Administrator that all loose material has been removed and the substrate is sound.

3.4 SURFACE PREPARATION OF CONCRETE AND REINFORCING STEEL

- .1 Refer also to Figure 1 in this Section.
- .2 Within 24 hours prior to infilling, sandblast the substrate to remove loose and deteriorated concrete, laitance, dust, dirt, oil, and any other material that could interfere with the bond of the new concrete. Provide a uniform surface profile of ICRI-CSP-5 or better. Sample surfaces are available for inspection in the Contract Administrator's office. These samples will be used as the standard of acceptance.
- .3 Surface preparation applies equally to any horizontal or vertical concrete surfaces to which the concrete is to bond.
- .4 Exposed reinforcing steel to be cleaned to near white metal and totally free of rust for the full circumference of the bar.
- .5 Secure any reinforcement which is loose by tying to other secured bars or by other methods approved by Contract Administrator.
- .6 Vacuum clean surface and/or air blast with oil free compressed air to remove residue and spent media created by surface preparation.
- .7 Maintain substrate in a clean condition using polyethylene film until the patch material is ready to be placed.
- .8 After all surface preparation is complete the Contractor shall request an inspection from the Contract Administrator to review the existing reinforcing steel. The purpose of this inspection is to provide assurance that all heavy corrosion and scale is removed from the bar. At that time, the Contract Administrator will review the condition of the reinforcing steel and determine if the addition of supplemental reinforcing steel will be required. At locations identified by the Contract Administrator, provide supplemental reinforcing steel to Section 03 20 00.
- .9 Final cleaning of the concrete substrate shall consist of a high pressure waterblast substrate at minimum 4,000 psi to remove any residual dust and dirt.

Figure 1: Surface Preparation for Concrete Delamination Repair



3.5 FIELD QUALITY CONTROL

- .1 Coordinate site work and inspections with Contract Administrator. Provide minimum 24 hours notice prior to each phase of the work.
- .2 Contract Administrator inspection to be completed at the following times:
 - .1 Prior to demolition to identify and quantify repair locations and types.
 - .2 Following initial demolition to confirm all loose, deteriorated, or unsound concrete has been removed from the substrate.
 - .3 Following concrete substrate preparation to review concrete surface profile and condition of reinforcing steel.

END OF SECTION