This specification describes the work of repairing defects in hardened portland cement concrete with a sand-filled mortar using an adhesive binder such as defined in ASTM C 881. It includes controls for adhesive labeling, storage, handling, mixing and application, surface evaluation and preparation as well as inspection and quality control.

Keywords: bond (concrete to concrete); concrete construction; epoxy resins, hardened concrete; mortars (material); quality control; repairs; resurfacing; specifications; standards.

FOREWORD

This foreword is included for explanatory purposes only; it does not form a part of Standard Specification ACI 503.4.

Standard Specification 503.2 is a reference standard which the Architect/Engineer may cite in the project specification(s) for any building project, together with supplementary requirements for the specific project.

This specification is written in the section and three-part format of the Construction Specifications Institute, but with the numbering system modified to ACI requirements. The language is generally imperative and terse.

A specification guide and checklist are included as a preface to, but not forming a part of Standard Specification ACI 503.4. The purpose of this guide and checklist is to assist the Architect/Engineers’ designer(s) and specifier(s) to properly choose and specify the necessary supplementary requirements for the project specification(s).
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SPECIFICATION GUIDE

SG1-Standard Specification ACI 503.4 is intended to be used essentially in its entirety, by citation in the project specification, to cover all usual requirements for repairing concrete with epoxy mortars. Individual sections, parts, and articles should not be copied into project specifications since taking them out of context may change their meanings.

SG2-However, adjustments to the needs of a particular project shall be made by the Architect/Engineer’s designers and specifiers by reviewing each of the items indicated in this specification guide and checklist and then including their decisions on each as mandatory requirements in the project specification.

SG3-These mandatory requirements shall designate specific qualities, procedures, materials, and performance criteria for which alternatives are permitted or for which provision is not made in Standard Specification ACI 503.4. Or exceptions shall be taken in Standard Specification ACI 503.4 if required.

SG4-A statement such as the following will serve to make Standard Specification ACI 503.4 an official part of the contract requirements:

Repairing concrete with epoxy mortars shall conform to all requirements of “Standard Specification for Repairing Concrete with Epoxy Mortars (ACI 503.4),” published by the American Concrete Institute, Detroit, Mich., except as modified by the requirements of this project specification.

SG5-The specification checklist that follows is addressed to each item of ACI 503.4 that requires the designer/specifier to make a choice where alternates are indicated, or to add provisions where they are not indicated in ACI 503.4, or to take exceptions to ACI 503.4. The checklist consists of one column identifying sections, parts, and articles of ACI 503.4, and a second column of notes to the designer/specifier to indicate the action required of them.

SPECIFICATION CHECKLIST

<table>
<thead>
<tr>
<th>Section/Part/Article of ACI 503.4</th>
<th>Notes to the Designer/Specifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1-General requirements</td>
<td></td>
</tr>
<tr>
<td>1.1 Scope</td>
<td>Indicate specific scope.</td>
</tr>
<tr>
<td>1.4 Reference standards</td>
<td>Review applicability of cited references and take exceptions if required.</td>
</tr>
<tr>
<td>Section 2-Materials and application</td>
<td>To whom sent?</td>
</tr>
<tr>
<td>2.1.2 Submittals</td>
<td></td>
</tr>
<tr>
<td>Section/Part/Article of ACI 503.4</td>
<td>Notes to the Designer/Specifier</td>
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</tr>
<tr>
<td>2.1.3.2 Application control</td>
<td>Mixing and application procedures submitted must be in accordance with product manufacturer’s instructions.</td>
</tr>
<tr>
<td>2.1.4.2 Storage of materials</td>
<td>Storing epoxy compounds at other than specified temperature range may result in degradation of the product. If such storage takes place, manufacturer should be contacted before product is used.</td>
</tr>
<tr>
<td>2.1.5.1 Environmental requirements</td>
<td>Performance of epoxy systems may be affected by temperature, humidity, and surface water. Strict adherence to the manufacturer’s recommendations should be maintained. Where other unusual conditions are encountered, the material manufacturer should be consulted before application.</td>
</tr>
<tr>
<td>2.2.1 Epoxy mortar</td>
<td>Epoxy mortars consist of a two component epoxy system plus aggregate which may or may not be incorporated in one or both components. Since the amount and type of aggregate is important to the performance of the mortar, the supplier and contractor must be in full agreement on selection and use. If the aggregate is furnished with proper instructions by the supplier the problem is minimized. The amount and type of aggregate selected can result in a mortar mix that will not adequately wet the concrete substrate and thus can result in a poor bond. The manufacturers’ recommendations should be closely followed regarding the need for and application of a primer for the mortar mix selected.</td>
</tr>
<tr>
<td>2.3.1 Preparation of surfaces</td>
<td>Specify limitations, if any, on use of mechanical abrasion, and on disposal of waste products.</td>
</tr>
<tr>
<td>2.3.2 Inspection of surfaces</td>
<td>Specify if architect/engineer will also inspect, and if hold points are required.</td>
</tr>
<tr>
<td>2.3.2.2 Pullout strength tests</td>
<td>The test method specifies the bonding of a steel pipe cap to the concrete surface with an epoxy adhesive. If the test results not in failure of the concrete but in cohesion of the epoxy resin adhesive or any failure in adhesion, the test shall be repeated. Repeated failures in adhesion, or cohesion in the adhesive, indicate improper cleaning of the concrete, incorrect adhesive, or faulty adhesive application techniques.</td>
</tr>
<tr>
<td>2.3.2.4 Surface condition of concrete</td>
<td>Surface condition of the concrete must be in accordance with the suppliers’ recommendation. Some mortars require a dry surface and a test method should be available to the applicator. Some epoxy adhesives may be capable of wetting the concrete surface at temperatures below 40 F. The specification should allow such use only if test data is available which conclusively demonstrates adequate bond at the actual concrete temperature expected.</td>
</tr>
</tbody>
</table>
ACI STANDARD

SPECIFICATION CHECKLIST (cont.)

<table>
<thead>
<tr>
<th>Section/Part/Article of ACI 503.4</th>
<th>Notes to the Designer/Specifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.4.1 Mortar application</td>
<td>Too thin an application of epoxy mortar can result in a surface without adequate integrity for intended use. Too thick an application can result in delamination caused by temperature changes. See “Use of Epoxy Compounds with Concrete” reported by Committee 503 for a more complete explanation.</td>
</tr>
</tbody>
</table>

SECTION 1-GENERAL REQUIREMENTS

1.1-Scope

1.1.1 This standard specification covers repairing of defects in hardened portland cement concrete with sand-filled epoxy mortar.

1.1.2 The provisions of this standard specification shall govern unless otherwise specified in the contract documents. In case of conflicting requirements, the contract documents shall govern.

1.2-Notation

1.2.1 ACI: American Concrete Institute

P.O. Box 19150
Detroit, MI 48219

1.2.2 ASTM: American Society for Testing and Materials

1916 Race Street
Philadelphia, PA 19103

1.3-Specification wording

1.3.1 The language of this standard specification is generally imperative and terse, and may include incomplete sentences. Omissions of phrases and of words such as “the contractor shall,” “in accordance with,” “shall be,” “as indicated,” “a,” “an,” “the,” “all,” etc., are intentional. Omitted phrases and words shall be supplied by inference.

1.4-Reference standards

1.4.1 The standards referred to in this Standard Specification ACI 503.4 are listed in Article 1.5.2 of this section, with their complete designation and title including the year of adoption or revision and are declared to be a part of this Standard Specification ACI 503.4 the same as if fully set forth herein, unless otherwise indicated in the contract documents.

1.4.2 ASTM standard

C 881-87 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

SECTION 2-MATERIALS AND APPLICATION

Part 2.1-General

2.1.1 Description - This section covers the requirements for surface preparation of hardened concrete and for materials and application of the epoxy mortar.

2.1.2 Submittals

2.1.2.1 Contractor shall submit manufacturer’s certification verifying conformance to material specifications specified in Part 2.2.

2.1.3 Quality assurance

2.1.3.1 Labeling - Clearly mark all containers with the following information:

a) Name of manufacturer
b) Manufacturer’s product identification
c) Manufacturer’s instructions for mixing
d) Warning for handling and toxicity

2.1.3.2 Application control - Submit mixing and application procedures for approval prior to use.

2.1.4 Product delivery, storage, and handling

2.1.4.1 Delivery of materials - Deliver all materials in sealed containers with labels legible and intact.

2.1.4.2 Storage of materials - Store all materials at temperatures between 40-100 F (5-38 C) unless otherwise recommended by manufacturer.

2.1.4.3 Handling of materials - Handle all materials in a safe manner and in a way to avoid breaking container seals.

2.1.5 Project conditions

2.1.5.1 Environmental requirements - Contractor shall comply with manufacturer’s recommendations as to environmental conditions under which the epoxy compound may be applied.

Part 2.2-Products

2.2.1 Epoxy mortar - ASTM C 881 Type III. Curing temperature requirements (Class) and viscosity (Grade), as well as special requirements regarding filling of either the components or the final system, shall be determined by supplier and contractor after project conditions have been established.

Part 2.3-Execution

2.3.1 Preparation of concrete surfaces

2.3.1.1 Concrete surfaces to which epoxies are to be applied shall be newly exposed parent concrete free of loose and unsound materials. Prepare surfaces by mech-
EPOXY RESINS

2.3.1.3 Mechanical abrasion—Use sandblasting, scarifying, waterblasting, or other approved means.

2.3.2 Inspection of concrete surfaces prior to mortar application

2.3.2.1 Inspect all concrete surfaces prior to application of mortar to insure that requirements of this Article 2.3.2 are met.

2.3.2.2 Surfaces shall be sound concrete which exhibits a minimum 100 psi pullout strength when tested in accordance with Appendix A of “Use of Epoxy Compounds with Concrete,” reported by ACI Committee 503.

2.3.2.3 Surfaces shall be free of any deleterious materials such as laitance, curing compounds, dust, dirt, and oil. Materials resulting from surface preparation specified in Article 2.3.1 shall be removed.

2.3.2.4 All concrete surfaces shall be dry as defined in Article 2.3.2.5 below unless a water-insensitive coating is used. Surface temperature shall be at least 40 F to permit wetting of concrete surface by epoxy coating.

2.3.2.5 Evaluate moisture content for concrete by determining if moisture will collect at bond lines between old concrete and epoxy coating before epoxy has cured. This may be accomplished by taping a 4 x 4 ft polyethylene sheet to concrete surface. If moisture collects on underside of polyethylene sheet before epoxy would cure, then allow concrete to dry sufficiently to prevent the possibility of moisture between old concrete and new epoxy.

2.3.3 Mortar mixes

2.3.3.1 Mix epoxy components in a clean container free of harmful residue or foreign particles.

2.3.3.2 Condition epoxy compound components to be at a temperature between 60-100 F (16-38 C), unless otherwise recommended by manufacturer.

2.3.3.3 Thoroughly blend epoxy components with a mechanical mixer to a uniform and homogeneous mixture. Mix small batches (up to 1 qt) by use of spatulas, palette knives, or similar devices.

2.3.4 Mortar application

2.3.4.1 Apply epoxy mortar to concrete surface by trowel or screed. Thickness shall be within the limits recommended by the manufacturer.

2.3.4.2 Work mortar into place and consolidate thoroughly so that all contact surfaces are wet by the mortar and entrained air is reduced to the level recommended by manufacturer.

2.3.4.3 Finish surface of mortar to texture, color, and smoothness required for the specific application.

2.3.4.4 Upon completion of finishing operations, allow mortar to cure in accordance with manufacturer’s recommendations.

2.3.5 Cleanup

2.3.5.1 Protect concrete surfaces, beyond limits of surface receiving mortar, against spillage.

2.3.5.2 Immediately remove any epoxy compound applied or spilled beyond desired areas. Perform cleanup with material designated by epoxy mortar manufacturer. Avoid contamination of work area.

2.3.6 Safety—Epoxy materials may be skin irritants or sensitizers to many people. Accordingly, advise applicators to avoid contact with eyes and skin, inhalation of vapors, and ingestion. Make protective and safety equipment available on site. Heed all label warnings by manufacturer. Make application in accordance with applicable safety laws.