

INTRODUCTION TO ICRI'S NEW GUIDE SPECIFICATIONS FOR STRUCTURAL CONCRETE REPAIRS

BY JOHN WEISBARTH

Many organizations have created specifications for new concrete construction. With over 70 billion yd³ (54 billion m³) of concrete placed in the United States since 1930,¹ a need certainly exists to specifically address means, methods, and materials for concrete repair.

Starting in 2004, under the leadership of the Strategic Development Council (SDC) of the ACI Foundation, Vision 2020 was developed for the concrete repair, protection, and strengthening industry. ICRI is an endorsing organization of the Vision 2020 document.² The mission of Vision 2020 is to provide a strategic plan for improvements in the concrete repair industry, making the industry more efficient, effective, green, safe, and fun by year 2020. Thirteen goals were identified, including Goal 4 to create repair specifications that support a repair code. The ACI 562 Repair Code³ was published in 2013. Two committees were formed to provide repair specifications: ACI Committee 563, Specifications for Repair of Structural Concrete in Buildings, to develop performance-based repair specifications; and ICRI Committee 110, Guide Specifications, to develop installation guide specifications. In 2006, ICRI Committee 110 began addressing the need for guide specifications.



Fig. 1: A need for proper specifications



Fig. 2: ICRI's new Guide Specification

The objective from the start was to prepare a standard format series of documents that are user-friendly and easy to modify for individual project circumstances. The goal was to enhance the quality of concrete repair by providing guidance in generating accurate project requirements for bid preparation. The documents are intended to help Owners and Design Professionals set clear roles and expectations for all project participants. Contractors should also benefit from less change orders and disputes. Figure 1 illustrates why proper specifications are needed in the concrete repair industry.

After many years of hard work and effort by many individuals on ICRI Committee 110, the first guide specification document, titled "Structural Concrete Repairs," will be available in January 2016 (Fig. 2). This specification is intended to be used as a technical section in a complete and coordinated project manual that includes Division 01 and other technical specifications, and a set of construction drawings with details and requirements specific to the concrete repair project.

This article summarizes the process the committee went through to create the guide specification and highlights the key, important provisions of the document. The article provides examples of using the specification in actual project scenarios to help illustrate the document's intended use.

FORMAT

The language in the guide specification document is different than the language used in a typical ICRI Technical Guideline document. ICRI Technical Guidelines provide consensus information for improving the quality of concrete evaluation, repair, restoration, strengthening, and protection. Various characteristics, procedures, and alternates with advantages and disadvantages are given. While specific recommendations are made, they usually are presented on a broad, nonrestrictive basis. The language is discretionary, permitting the user latitude in judgment concerning particular needs.

Guide specifications offer a methodology for standardizing the essential requirements that should be determined for a specific type of repair without imposing restrictive, single-solution requirements. The format of the guide specification requires the user to tailor the document for application to a specific repair.

The document follows the 3-Part MasterSpec format:

PART 1—GENERAL

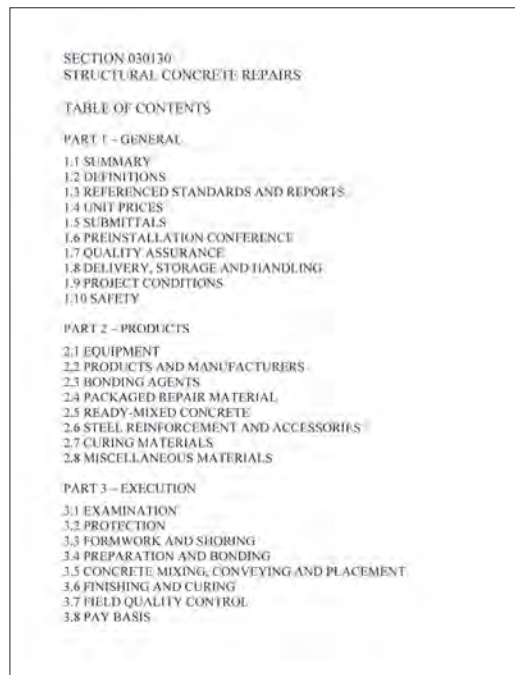
PART 2—PRODUCTS

PART 3—EXECUTION

Figure 3 shows the Table of Contents for the "Structural Concrete Repairs" guide specification document. Three colors have been used throughout the document to distinguish the purpose of the text (Fig. 4). Black text is specification text, indicating to the specification user the essential requirements that are generally accepted as industry standards. Blue text indicates optional requirements, or situations where the specification user must choose between multiple options based on the needs of the project. Blue text must be accepted or modified, and changed to black text prior to issuing the document to avoid confusion regarding multiple alternatives or suggestive language. Red text indicates commentary to the specification, and serves to explain and clarify the specification requirements. A Word document is also provided with the document where the red text is formatted using hidden text, which permits it to be turned on or off during viewing and printing.

KEY SPECIFICATION COMPONENTS

The discussion that follows presents several articles in the specification that require consideration of alternatives, and some examples of the rationale used to edit the document under a given set of circumstances.



SECTION 030130
STRUCTURAL CONCRETE REPAIRS

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- 3.7 FIELD QUALITY CONTROL
- 3.8 PAY BASIS

Fig. 3: Table of Contents for guide specification document

2.4 PACKAGED REPAIR MATERIAL

Article 2.4 provides a list of generic types of packaged repair materials. The materials shall be selected based on the judgment of the Design Professional. Guidance can be found in ICRI 320.2R and ACI 546. Recommendations from material suppliers and contractors are important sources of assistance in the selection of the materials. The Design Professional should choose products based on a determination of the properties that are most important for the project. The properties should be coordinated with the listed products to provide the Contractor with criteria for choosing alternatives.

A. Cementitious Proprietary Repair Material:

1. Packaged cementitious repair material shall have a minimum compressive strength of 5000 psi (34.5 MPa) at 28 days.
2. Packaged cementitious repair material shall contain aggregate gradation appropriate for the depth of concrete repair specified. For repairs greater than 1 in. (25.4 mm) in depth unless stated otherwise by the manufacturer, coarse aggregate shall be used. If coarse aggregate is to be added to a packaged repair mortar, the mixture ratio, gradation, and type must be in accordance with the manufacturer's specifications, and the following: *Aggregate shall comply with ASTM C33/C33M and the manufacturer's requirements. Add only as permitted by the packaged repair mortar manufacturer.*

Fig. 4: Sample article showing the three colors of text used in guide specification document

PART 1—GENERAL

Article 1.1, SUMMARY, of the document provides a description of the work to be performed on the project. Red commentary text explains the intent of the section. Black text outlines generally accepted industry standards requirements that are included based on the project. Blue text is provided for a variety of repair scenarios. The Design Professional is expected to select one of the repair scenarios, or add one that is specific to the project. For instance, top-surface partial-depth concrete slab repairs may be chosen for a parking garage top surface repair project while full-depth concrete slab repairs (blue text) could be selected for a balcony slab edge repair

project. The chosen blue text would be changed to black to be included in the final specification section. Unused blue text would be deleted.

This process is continued throughout the remainder of the document, reviewing red commentary text, including appropriate black text, selecting project-specific blue text, changing selected blue text to black text, and deleting unused blue text. Once the entire document has been reviewed and modified, the Design Professional has a comprehensive document to release for bidding.

Article 1.3, REFERENCED STANDARDS AND REPORTS, provides 52 references in the specification text with an additional 19 references in the commentary. In addition to ICRI, references are cited from the American Concrete Institute (ACI), American Association of State Highway and Transportation Officials (AASHTO), ASTM International, American Welding Society (AWS), Canadian Standards Association (CSA), and the Society for Protective Coatings (SSPC). References are cited as the basis for the procedures described in the specifications.

Article 1.4, UNIT PRICES, is used if the Design Professional decides to include the Pay Basis in Division 03 of the specification instead of, or in addition to, any Pay Basis discussed in Division 01. In concrete repair and restoration work, it is often too general to simply define a unit of measurement such as square feet (ft²), square meters (m²), linear feet (ft), or meters (m). The components of the repair can include demolition, surface preparation, formwork, reinforcing bar replacement, post-tensioned tendon splicing and stressing, curing, and many other activities. Including Pay Basis in Division 03 allows for the definition of the scope of Work items to be included in the unit price for the Work. The pay basis may be unit price or lump sum based on a quantity allowance. Refer to Article 3.8 below.

Article 1.9, PROJECT CONDITIONS, can include environmental conditions as well as mechanical and electrical equipment that could affect the work. The Design Professional should edit paragraphs which address containment of dust, the control of equipment exhaust fumes, air monitoring in cases where solvents or other airborne contaminants could be a concern, and conditions that could affect the work.

Article 1.10, SAFETY, references ICRI Technical Guideline No. 120.1, "Guidelines and Recommendations for Safety in the Concrete Repair Industry," for safety considerations that should be addressed in the Specification.

PART 2—PRODUCTS

A discussion of the equipment used on a concrete repair project site is provided in the com-

mentary of Article 2.1, EQUIPMENT, primarily aimed at detailing the effects of various types of equipment on the overall project. For instance, the size of chipping hammers for concrete removal may lead to microcracking of non-deteriorated concrete when the hammer size is too large for the specific project application.

Due to the wide variety of equivalent or comparable repair materials available, Article 2.2, PRODUCTS AND MANUFACTURERS, allows the Design Professional to decide whether the specification will be performance based, list one material, or list multiple materials, and if substitutions will be allowed.

Individual articles are then presented for key concrete repair materials: bonding agents, repair materials (packaged and ready mixed concrete), steel reinforcement, and curing materials. A final article in PART 2 addresses miscellaneous materials used on concrete repair projects, including sacrificial anodes for use in cathodic protection and corrosion-inhibiting coatings.

For a parking garage repair project, the user can modify the specification to select packaged repair material or ready mixed concrete, depending on the specific project situation. A decision can also be made on which product performance criteria is preferred. In the parking garage repair example, a higher priority may be given to flexural strength over compressive strength. These type choices can be made throughout PART 2—PRODUCTS.

PART 3—EXECUTION

The Execution portion of the specification addresses the items related to actual repair construction on the project site. Notable items include formwork and shoring, surface preparation and bonding, concrete placement, and field quality control.

Pre-planning for a concrete repair project is very valuable. Article 3.1, EXAMINATION, presents the importance of layout of the concrete repair area including coordination with the Design Professional. Guidance on sounding concrete and layout of concrete repairs is provided in this section. Sequencing of equipment staging and materials must be thoroughly considered prior to any work being undertaken.

As most repair projects are conducted while access to adjacent areas remains available, safety of pedestrians and workers is very important on any concrete repair project. Article 3.2, PROTECTION, covers items related to repair that may not require consideration in new construction: protection of property and people, noise control, vibration, and dust control to name a few.

The bond of the repair material to the existing concrete is critical to a successful repair. Methods

for proper surface preparation and bonding vary from project to project based on many variables. Article 3.4, PREPARATION AND BONDING, provides guidance for these topics.

The equipment used for removing deteriorated concrete and performing surface preparation must be given ample consideration to provide an adequate surface profile without affecting the bond of the repair material. Using equipment that is too heavy for the specific type of removal can lead to microcracking in the prepared concrete surface, which reduces bond strength. An example of this is using a 90 lb chipping hammer to remove deteriorated concrete when a 15 lb hammer would be adequate.

Full-depth and partial-depth concrete repair geometry and removal are also considered. For partial depth, recommendations are provided for proper depth removal. Individual paragraphs have been provided for slabs on ground, walls, columns, and beams to address the concrete removal process for different applications. Blue text has been used in these paragraphs with the intent that the Design Professional insert the desired depth to the requirements for the specific project, then change the text color from blue to black.

Article 3.4 also provides requirements for the cleaning of reinforcing steel following the concrete removal. The specification addresses treatment of exposed reinforcing steel, how to clean the steel, when the existing steel is acceptable, when to replace reinforcing steel based on section loss, how much steel to replace, and how to address replacement steel. Corrosion-resistant reinforcing bar coatings and sacrificial anodes for passive cathodic protection are also presented in this article of the specification.

In addition, repair bonding options are outlined in Article 3.4, including a mortar scrub coat (whether with cement, sand, and water or the repair material and water), a scrub coat of material mixed with latex admixture, and epoxy adhesives.

Article 3.6, FINISHING AND CURING, states requirements for finishing concrete to match adjacent existing concrete. A trowel finish may be required at interior conditions. A broom finish can be used to provide a nonslip finish. In other cases, a float finish may be all that is required to prepare the surface for a coating. The Design Professional defines the desired finish in the specification.

Curing generally helps to minimize drying shrinkage cracking. Curing should be coordinated with special requirements from the manufacturer of packaged repair materials, and may be specified differently for ready mixed concrete. Blue text is provided for the Design Professional to specify the desired level of curing based on the project

geographic location, time of year, specific site situations, plus environmental conditions. For example, an exposed top level of a parking garage on a sunny, windy day in the winter in Chicago, IL, may require more attention to finishing and curing than a 70°F (21°C) day in Phoenix, AZ. The commentary provides guidance for the Design Professional to consider the site conditions when preparing the specification document.

Article 3.7, FIELD QUALITY CONTROL, outlines several requirements to ensure the desired performance criteria are being met in the field.

Article 3.8, PAY BASIS, may be unit price, or lump sum based on a quantity allowance. Unit price methods of measurement are defined in this article.

FUTURE GUIDE SPECIFICATIONS

With the completion of this first guide specification, a template is now in place for developing additional guide specifications, with unbonded post-tensioning repair, epoxy injection, and bonded overlay repairs being considered or under development. ICRI Committee 330, Strengthening and Stabilization, has also recently completed their efforts on a guide specification for FRP installation, which is scheduled to be available in early 2016. Suggestions for other guide specifications are encouraged from ICRI committees and members. Contact the ICRI Committee 110 Chair with suggested topic(s) to consider.

REFERENCES

1. Shiu, K.N., and Goodwin, F., "Vision 2020—Before and After," *Concrete Repair Bulletin*, V. 27, No. 5, Sept.-Oct. 2014, pp. 34-41.
2. "Vision 2020, A Vision for the Concrete Repair, Protection, and Strengthening Industry," Strategic Development Council, Farmington Hills, MI, May 2006, <http://www.concretesdc.org/COMMITTEES/GetDocumentPublic.asp?DocID=71408>. (last accessed Dec. 2015)
3. ACI Committee 562, "Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings (ACI 562-13) and Commentary," American Concrete Institute, Farmington Hills, MI, 2013, 59 pp.



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