ACI 364.9T-xx

Cracks in a Concrete Repair

Keywords: cracking; cracks; durability; nonstructural repair; service life; shrinkage; structural repair.

Question

Should cracks in a concrete repair be of concern?

Answer

Cracking can adversely affect the performance and service life of the repair, as cracks provide a more direct path for the ingress of deleterious elements into the repair, creating a durability concern. For structural repairs, cracks may adversely affect the repair performance and the load-carrying capacity of the repaired structure. Additionally, cracking may be an aesthetic concern. In consideration of the above, the licensed design professional should evaluate the cause(s) of the cracks in repair and, if needed, develop remediation means. ACI 562 requires cracking mitigation to be considered in repair design.

Discussion

Regardless of the nature of the repair (structural or nonstructural), formation of cracks within the repair boundaries or adjacent to the repair may adversely affect the performance and the durability of the repair.

For structural repairs that are designed to participate in resisting loads, cracking may alter the intended load path and reduce the capacity of the repaired structure or element. Thus, cracks in repaired portions of the structure may not be acceptable. In such cases, the effect of cracking on structural performance of the repaired structure should be evaluated by the licensed design professional.

Regardless whether the repair is structural and nonstructural, concrete repairs are intended to mitigate the ingress of potentially deleterious elements, such as water, chlorides, carbon dioxide, and sulfates, into the repaired element (Fig. 1). The transport of the deleterious elements from the concrete surface is appreciably faster through cracks; thus, cracking can be one of the most influential factors in the overall durability of the repair, especially in harsh exposures. From a durability point of view, crack-free repairs are desirable; however, in practice, cracking in repairs does occur. Therefore, the goal should be to minimize the extent and width of the cracks.

Guidance on tolerable crack widths in concrete structures is presented in ACI 224R and ACI 224.1R. While these documents were primarily developed for cracking in new concrete structures, the recommendations can be applied to concrete repairs. The tolerable crack widths reported by ACI Committee 224 are intended to prevent premature deterioration. Guidance on achieving crack-resistant repairs can be

found in documents prepared by the American Concrete Institute (ACI 546.3R), International Concrete Repair Institute (ICRI 310.1R; ICRI 320.2R) and U.S. Army Corps of Engineers (Vaysburd et al. 1999).

Depending on the nature of the repair and sensitivity of the repair components to cracking, the repair drawings or specifications can include tolerable cracking criteria and specify measures to address cracks that can affect the repair performance or durability. Based on previous experience and specifics of the repair project, the licensed design professional may specify more stringent cracks width values than the ones recommended in ACI 224 documents for acceptance of the repairs. In specifying the repair material(s), requirements relating to shrinkage cracking sensitivity can be issued based on parameters determined in accordance with test procedures such as ASTM C157/C157M and ASTM C1581/C1581M.

Summary

Cracking in a repaired portion of a concrete structure may compromise the intended performance of the repair to serve a desired function and may reduce the service life of the repaired structure. The outcome of an evaluation of cracks in repairs largely depends on the type of repair, extent, depth, and width of cracks and exposure of the repaired structure. Cracks should be evaluated to determine the appropriate course of action.

References

Committee documents are listed first by document number and year of publication followed by authored documents listed alphabetically.

American Concrete Institute

ACI 224R-01(08)—Control of Cracking in Concrete Structures

ACI 224.1R-07—Causes, Evaluation, and Repair of Cracks in Concrete Structures

ACI 546.3R-14—Guide for the Selection of Materials for the Repair of Concrete

ACI 562-19—Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary

ASTM International

ASTM C157/C157M-17—Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

ASTM C1581/C1581M-18a—Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage

International Concrete Repair Institute

ICRI 310.1R-2008—Guidelines for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

ICRI 320.2R-2009—Guidelines for Selecting and Specifying Concrete Repair Materials

Authored documents

ACI Committee 364, 2003, "FAQs: Cracks in a Repair," *Concrete International*, V. 25, No. 7, July, pp. 14-15.

Vaysburd, A. M.; Emmons, P. H.; McDonald, J. E.; Poston, R. W.; and Kesner, K. E., 1999, "Performance Criteria for Concrete Repair Materials, Phase II Summary Report," *Technical Report REMR-CS-62*, U.S. Army Corps of Engineers, Vicksburg, MS, 72 pp.

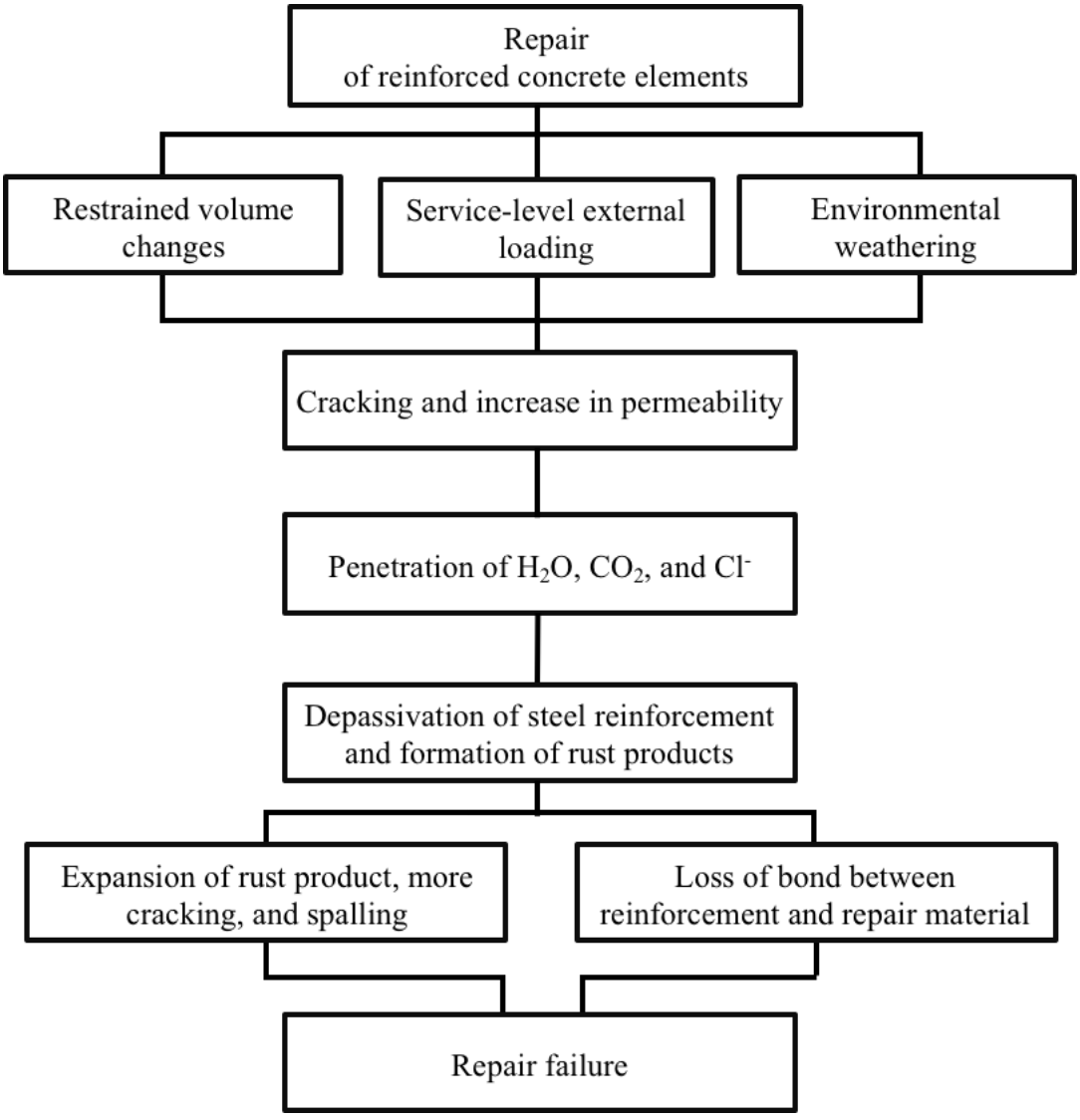

Fig. 1—Concrete repair cracking-failure interaction model (adapted from ACI Committee 364 [2003]).

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