



CRACKS IN A CONCRETE REPAIR—TECHNOTE

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 aforementioned, the licensed design professional should evaluate the cause(s) and consequences of cracks in the repair and, as needed, develop a remediation approach. If the cracks compromise the load-carrying capacity of the repaired structure, appropriate measures should be taken. [ACI 562](#) requires cracking mitigation to be considered in repair design.

Discussion

Irrespective of the nature of the repair (structural or nonstructural), the 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 the structural performance of the repaired structure should be evaluated by the licensed design professional.

Regardless of whether the repair is structural or 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. The diagram presented in Fig. 1 summarizes the deterioration mechanisms that may be initiated in a repaired reinforced concrete element as a result of the exposure or loading conditions ([Vaysburd et al. 2017](#)). When cracks form, the permeability of the repair material generally increases. The crack progression and the resulting increase in permeability allows more water and aggressive chemicals penetration into the repair and concrete substrate, enabling corrosion of reinforcement and further deterioration. Such a chain reaction of cracking – more permeable repair – corrosion of reinforcement – more cracking may eventually result in irreversible deterioration and failure of the repair. Thus, cracking can be one of the most influential factors in the overall durability of the repair, especially in harsh exposure conditions. 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](#); [ACI 562](#)), the International Concrete Repair Institute ([ICRI 310.1R](#); [ICRI 320.2R](#)) and the 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. Based on previous experience and specifics of the repair project, the licensed design professional may specify more stringent crack 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 effects can be issued based on parameters determined in accordance with test procedures such as [ASTM C157/C157M](#) and [ASTM C1581/C1581M](#).



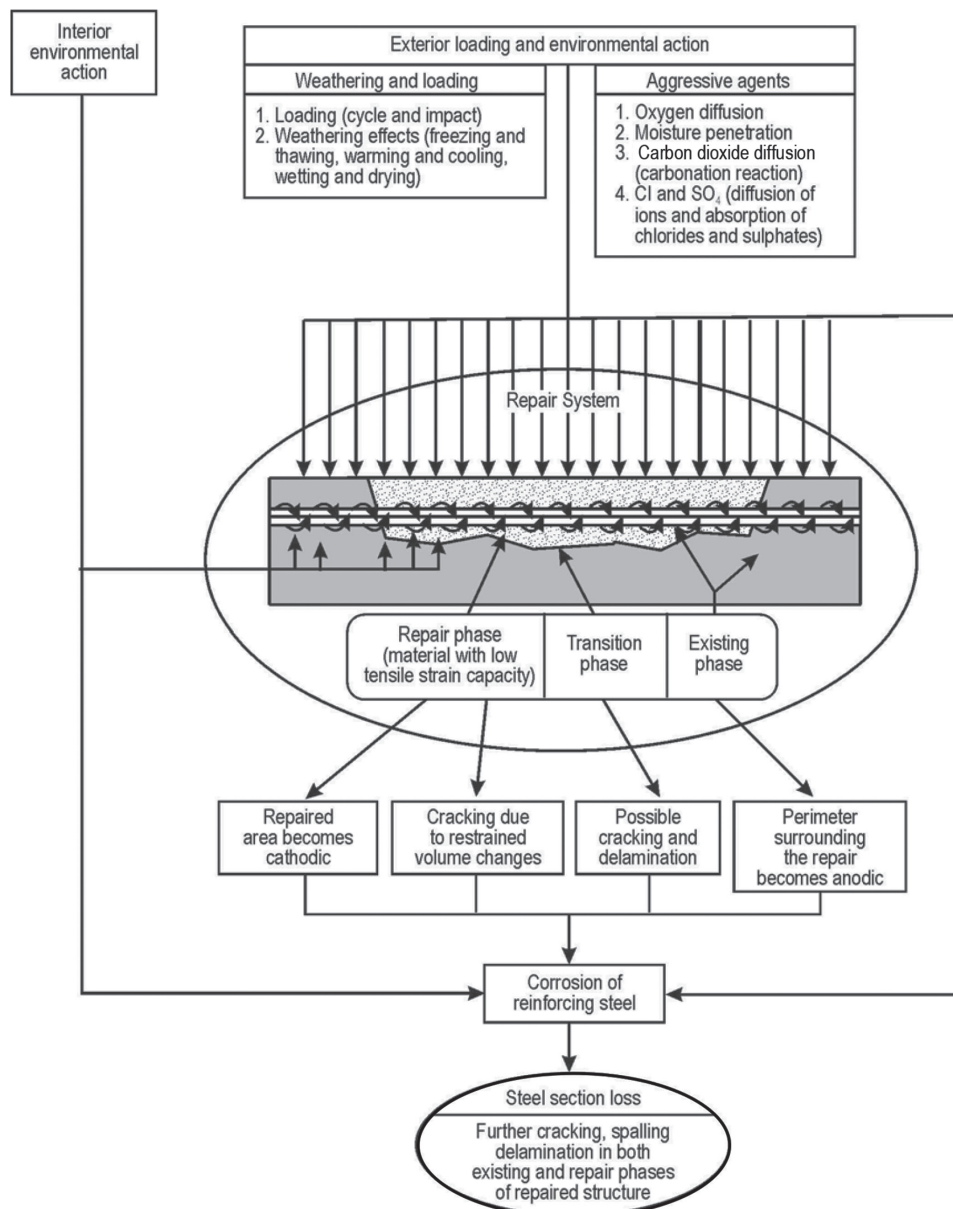


Fig. 1—Reinforced concrete repair cracking-failure interaction model (Vaysburd et al. 2017).

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; the extent, depth, and width of the cracks; and the 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 to Materials Selection for Concrete Repair
- ACI 562-19—Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary