

Cracks in Structural Concrete

ASCC Position Statement #33

Some concrete professionals believe that reinforced concrete structures should not crack. With that belief, when cracking does occur, they often claim that the concrete contractor caused the cracks and should pay for repair. Cracks in reinforced concrete, however, are not a defect but are specifically included as part of the design process.

Design professionals using ACI 318-08, "Building Code Requirements for Structural Concrete," understand that meeting Code provisions for beams and slabs provides crack control. The Commentary (R10.6.1) states that "structures designed by working stress methods and low steel stress served their intended functions with very limited flexural cracking. When high-strength reinforcing steels are used at high service load stresses, however, visible cracks should be expected." The Commentary section below illustrates the typical crack width:

R10.6.4 Crack widths in structures are highly variable. In Codes before the 1999 edition, provisions were given for distribution of reinforcement that were based on empirical equations using a calculated maximum crack width of 0.016 in. The current provisions for spacing are intended to limit surface cracks to a width that is generally acceptable in practice but may vary widely in a given structure.

That section further states that:

Research shows that corrosion is not clearly correlated with surface crack widths in the range normally found with reinforcement stresses at service load levels.

Thus, for structures designed in accordance with ACI 318-08, corrosion is not currently a concern when surface crack widths are in the range normally found with reinforcement stresses at service load levels.

In *Reinforced Concrete* (Prentice Hall, 2009), James K. Wight and James G. MacGregor echo ACI 318-08 by stating:

- "It should be noted that reinforced concrete structures normally crack when carrying service loads."
- "Corrosion of reinforcement has traditionally

been related to crack width. More recent studies (3 references) suggest that the factors governing the eventual development of corrosion are independent of crack width."

ACI 224R-01, "Control of Cracking in Concrete Structures," indicates 0.016 in. as a reasonable crack width for reinforced concrete under service loads for a dry air exposure. The document also notes that a portion of the cracks in the structure will exceed these values. With time, a significant portion can exceed these values, and the width may double.

During the building process, the construction loads during reshoring, storing materials, and as a result of the work processes are limited by the engineer to the design service loads. As ACI 318 indicates, flexural cracks will occur and be visible under service loads. ACI 318 also indicates that the crack width is inherently subject to wide scatter (ACI 224R-01 indicates a coefficient of variation of 40%) and is influenced by shrinkage and temperature.

In addition to cracks due to service loads, cracks also result from restrained shrinkage and thermal contraction. Section 7.12 of ACI 318-08 includes requirements for shrinkage and temperature steel to control crack widths. ACI 224R-01 states that cracking due to drying shrinkage can never be eliminated in most structures.

ASCC concrete contractors will meet with the design team, construction manager, and general contractor to discuss crack expectations for the project. Concrete contractors want to ensure awareness by all parties that cracking will occur when the structure is built in accordance with the Contract Documents.

If you have any questions, contact your ASCC concrete contractor or the ASCC Technical Hotline at (800) 331-0668.



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