

Thin Concrete Cover Reduces Fire Resistance

Concrete cover requirements as protection of reinforcement for durability are stated in ACI 318-11 “Building Code Requirements for Structural Concrete.” But while most contractors are aware of these requirements they aren’t as familiar with ACI 216.1-07 “Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies.” The “ACI Fire Code” is part of the International Building Code (IBC). And while concrete cover protects the reinforcement from the weather, it also protects the reinforcement during a fire.

During a fire, the exposed concrete surface temperatures can be greater than 1500F. The protected reinforcing steel inside the concrete would be slightly cooler but for temperatures of about 1200F the steel strength is reduced by more than 50%. Concrete cover plays an important role in reducing the temperature of the steel and thus maintaining steel strength and member strength for a given fire resistance.

The ACI Fire Code includes Tables stating the (1) minimum concrete cover for reinforcement in concrete floors and roof slabs, (2) minimum concrete cover for nonprestressed and prestressed flexural reinforcement in beams, and (3) minimum concrete cover for reinforcement in columns. The concrete cover varies based on the fire rating, which varies from 1 to 4 hours. As the fire resistance rating increases, the required concrete cover increases.

But what happens if the concrete cover is less than that stated in the Tables in the ACI Fire Code? Fortunately, the ACI Fire Code allows a tolerance on “minimum concrete cover” by stating that the tolerances in ACI 117 apply. Thus a concrete cover that is 3/8 to 1/2 inch less (ACI 117 tolerances) than that required in the ACI Fire Code could still be acceptable. Also, the Tables in the ACI Fire Code are conservative and the Code provides analytical methods for calculating structural fire resistance and cover protection of concrete flexural members.

Most architects and engineers are not familiar with these calculations and generally base the fire rating on the Table criteria for minimum concrete cover. The Table values are conservative. Therefore, if there is a large amount of reduced concrete cover, the contractor would benefit by finding an engineer who can perform the calculations and show that the concrete member with the reduced concrete cover still meets the fire rating.

The ACI Fire Code allows finish materials to be included in the fire rating. Adding a layer of drywall or plaster could add 30 minutes to the fire rating. In addition, it is also possible to just add a cementitious mortar or coating to bring the concrete cover back to that specified. These options may be limited by the exposure (interior or exterior) and the architectural requirements.

Finally, another option is to consider applying a paint or coating that improves the fire resistance. Called intumescent paints or coatings, they retard heat transfer. The manufacturers provide data and recommendations that indicate how much paint or coating to apply to increase the fire resistance to the appropriate level.

Factors to consider include the cost of the coating and the labor cost of application, whether the paint or coating color must match the concrete color, and whether an additional exterior protective coating needs to be applied if it’s exterior concrete.

If you run into this problem give Ward or me a call. Over the years, we have seen a few instances of out-of-tolerance cover over reinforcement resulting in the contractor having to make repairs to restore the desired level of fire resistance. We can assist you in minimizing cost and schedule delays by using some of the strategies discussed for bringing the concrete back to the original fire rating.