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TechNote

Repairs for Reinforcement with Shallow Cover

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Introduction

A reinforced concrete structure needs a surface repair due to corrosion of the reinforcement, which resulted from an inadequate concrete cover (less than code minimum).

Question

What are the recommended remedies to extend the service life of this type of surface repair?

Answer

Many surface repairs have limited service life due to inadequate protection against corrosion-related deterioration of embedded steel reinforcement. A number of protection options are available to extend the service life of surface repairs, such as increasing cover thickness, enhancing the concrete performance using admixtures or coatings, coating the reinforcement, installing cathodic protection measures, or a combination of these. The degree of corrosion protection required is a function of the exposure conditions; the actual concrete condition; and the type, layout, and service use of the structure. Therefore, final selection and design of a remedial measure should consider these factors. The development of the reinforcement must also be considered to maintain the structural integrity of the structure. Furthermore, in accordance with ACI 562, the repaired elements should comply with applicable building code requirements and relevant fire regulations valid at the project location.

Discussion

Prior to designing or implementing repair, the contributing cause(s) for the noted deterioration should be identified. To offer appropriate and cost-effective remedial actions, one needs to identify the existing conditions, such as chloride levels, state and characteristics of the concrete, actual concrete cover thickness, and the required level of protection for the structures. Geographic location and surface orientation are two key controlling factors.

Geographic location—ACI 362.1R lists five exposure groups used to describe the different levels of exposures for parking structures, as shown in Fig. 1. Some reinforced concrete structures in the regions with northern climates (Zone III) are exposed to deicing salt and freezing-and-thawing cycles. Corrosion protection is critical for these elements. By the same token, structures in regions with southern climates (Zone 1 and part of Zone II6), with the exception of coastal exposures, typically need a lower level of corrosion protection because of the differing exposure.

Surface orientation—One consideration for having the appropriate corrosion protection level provided by concrete cover is the orientation of the surface (horizontal or vertical). Vertical surfaces are not usually as prone to severe corrosion-related deterioration as horizontal surfaces; an exception is where calcium chloride was added to concrete to facilitate winter construction. Such practice was commonly done before the 1970s. The primary reason is that water is not likely to stay on the vertical surfaces to penetrate through the concrete cover. As a result, protection requirements for elements with vertical surfaces may not need to be as stringent as that for horizontal surfaces.

Cracking and low-quality concrete can contribute to corrosion-related damage. Therefore, to select the proper level of surface protection, one should consider the physical condition and material properties of the structural element.