# Mitigation of Early-Age Cracking of High Performance Concrete

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With a mounting demand for enhancing the durability and extending the service life of bridge structures, high-performance concrete (HPC) has become a material of choice for bridge deck applications. This transition, however, has witnessed certain difficulties, especially with increasing the likelihood of early-age cracks. Compared to traditional concrete, HPC has a lower water-to-cement ratio, utilizes more mineral and chemical admixtures, and often has a higher mortar fraction. Such mixture characteristics result in a faster setting time, quicker strength gain, higher heat of hydration (and thermal stress), higher plastic and autogenous shrinkage, and eventually greater potential for surface and through-slab cracking within only first few days after concrete placement. The formation and propagation of cracks in concrete bridge decks often lead to strength and durability problems, mainly because such cracks permit the ingress of water, chlorides, sulfates, and other potentially corrosive agents into the bridge deck. The current study aims to investigate various strategies focused on the use of synthetic fibers for the mitigation of early-age cracking of HPC. For this purpose, a number of HPC mixtures are modified with the addition of fibers of various type (polypropylene and carbon fibers), geometry (micro and macro fibers), and dosage (0.25, 0.5 and 1% by volume of concrete for polypropylene fibers and 0.25 and 0.5% by volume of concrete for carbon fibers). A comprehensive set of laboratory tests are performed to investigate the workability and strength properties of developed mixtures as well as their resistance to early-age cracking and transportation of aggressive ions. The outcome of this study provides recommendations in utilizing micro-synthetic fibers in the bridge decks, especially where the structural components are susceptible to early-age shrinkage cracking.

*Keywords:* High-performance concrete; Early-age cracks; Synthetic fibers; Crack mitigation strategies