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Bridge Decks Reinforced with High-Strength, High-Corrosin Resistant Steel

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Abstract

Corrosion of steel reinforcement is undoubtedly a leading cause for deterioration of concrete bridges. Over the last few decades, this fact has led to the development of various technologies such as cathodic protection systems, chemical corrosion inhibitors, high-performance concretes, epoxy coated bars, non-metallic reinforcement, and corrosion-resistant steels.

The development of the novel commercially available, Micro-composite Multi-structural Formable (MMFX) steel provides high corrosive resistance characteristic in comparison to conventional carbon steel without the use of coating technologies. This characteristic was achieved by proprietary alteration of the steel composition and microstructure. In addition, the control of MMFX steel's morphology of its microstructure has resulted in higher tensile strength. Use of the new steel could lead to potential savings through lower reinforcement ratios and longer service life due to its high corrosion resistance. MMFX steel is gaining more attention in the US due to its unique characteristics and it offers a promising alternative to conventional steel. However, there is insufficient information on the performance of bridge decks using MMFX steel as main reinforcement

This paper describes an experimental program of three full-scale bridge decks tested to failure to assess the MMFX steel structural performance as main flexural reinforcement. The three bridge decks are identical in all aspects except for the type and amount of steel used. Each deck consists of two spans and two cantilevers,

supported in composite action by three post-tensioned concrete girders. The overall nominal dimensions of the bridge decks are 6600 x 4000 x 220 mm. The first bridge deck is reinforced with MMFX steel, having a top and bottom reinforcement ratio of 0.54 percent. The second bridge deck is reinforced with conventional Grade 60 A615 steel for comparison purpose, using the same reinforcement ratio as the first deck. The third bridge deck is reinforced with MMFX steel, having a reinforcement ratio 33 percent less than that of the first deck to utilize the higher strength characteristic of the MMFX Steel. The first bridge deck prior to testing is shown in Figure 1.

The paper also presents the test results and discusses the general behavior of the bridge decks using the three reinforcement configurations, including the failure mode in each case. A comparison between flexural and punching shear design concepts for bridge decks is discussed. Test results are compared to analytical results obtained from the finite element analysis program, “ANACAP” (Anatech Concrete Analysis Program version 3.0, 2004). Design guidelines for using MMFX steel as reinforcement for bridge decks are proposed.

Figure 1: Full-scale bridge deck reinforced with MMFX steel

Biography

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