Use of Fiber-Reinforced Self-Consolidating Concrete to Enhance Serviceability Performance of Damaged Beams

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Introduction and Background
The efficiency of a given repair depends on both the repair material quality and the ability of the material to fill the section to be repaired, especially in congested areas. Fiber-reinforced self-consolidating concrete (FR-SCC) can be placed easily in comparison with conventional FRC. In addition, (FR-SCC) can improve tensile and flexural strengths while reducing cracking density and crack opening. In this project, the Rutgers University team, with support from and collaboration with RECAST, is utilizing FR-SCC as repair material for structural elements affected by corrosion.

Objectives
1. To investigate key engineering and structural properties of FR-SCC for infrastructure repair and construction.
2. To evaluate the structural behavior of full-scale repaired beams with simulated bar sections reflection corrosion reduction of the steel and concrete cover lost.
3. To verify ACI 544 code equation for predicting the cracking load with the experimental results.

Experimental Program
1. Design Mixtures and Test the Mechanical and Bond Strength Tests Properties
2. Compatibility and Bond Strength Tests Properties

Results
1. Failure at the center was observed which refer to a good compatibility. This is mainly due to the low drying shrinkage of developed FR-SCC.
2. The recorded failure was in both substrate and repair which means a good bond result.

Conclusions
1. The incorporation of PPF fibers can largely affect SCC workability and placing ability in comparison with STF fibers. Therefore, the maximum fiber percent for the designed mixtures should not exceed 0.5% and 0.2% for STF and PPF, respectively.
2. The use of fiber in FR-SCC has improved all of the strength properties compared with the SCC mixtures.
3. A reduction of 37% in free drying shrinkage at 56 days was observed when using 0.5% of steel fiber in the 35SL50S mixture compared to the 35SL mixture which is considered as the control mixture without fibers. Mixtures made with 35% SL exhibited lower shrinkage than those with 10% SF. By reducing the shrinkage crack size and distribution, the repaired structural element can be more durable.
4. Most of the FR-SCC mixtures showed good compatibility and bond with the substrate, which is an important factor for a successful repair.
5. The repair with FR-SCC could be an efficient and viable option to repair the damaged beam, protect it from further loss, and to increase its cracking capacity.
6. The ACI 544 code first-crack composite strength provides safe prediction for both control and FR-SCC repaired beams.

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