Public Abstract
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Title:FLEXURE SHEAR RESPONSE IN FATIGUE OF FIBER REINFORCED CONCRETE BEAMS WITH FRP TENSILE REINFORCEMENT

The primary goal of this MODOT-sponsored investigation is to characterize the flexural shear response, fatigue behavior, and performance of fiber reinforced concrete flexural sections with fiber reinforced polymer tensile reinforcement for use in bridge deck applications. Results from a series of flexural fatigue tests, on plain and fiber reinforced concrete flexural specimens, are reported and discussed.

First, to establish the compressive response of concrete with differing fractions of polypropylene fibers by volume, individual compressive tests were performed on both lab-mix and ready mix concrete specimens. In the lab, concrete mixes with 0.0%, 0.5%, and 1.0% by volume, fibrillated polypropylene fibers were produced. Along with these, specimens from the various beam castings that were part of the Steel Free Bridge Deck project were also taken. These concrete ready-mix batches were either plain concrete or contained 0.5% fibers. Tests on both 6 inch standard cylinders and 4 inch cylinders were performed. The compression tests on the 6 inch cylinders were performed in standard open-loop testing apparatus and provided load and deflection data up to ultimate strength. The 4 inch cylinders were tested in closed-loop testing apparatus and provided post-peak load deflection data as well as pre-peak data.

After the compressive response of the fiber reinforced concrete was established, four point bending tests were performed on 36 lab cast beam specimens. The beam specimens had cross-sectional dimensions of 6 inches x 9.5 inches (width x height). The span was 48 inches and the loading points were 8 inches apart (4 inches each side of the mid-point). The depth of reinforcement was 8 inches.

There were two castings of beams; one with plain concrete and one with 0.5% by volume polypropylene fibers, both using ready mix concrete. For each casting there were 18 beams; 6 with #8 GFRP, 6 with #4 GFRP, and 6 with #4 CFRP tensile reinforcement. For each set of 6 beams, two were tested under quasi-static loading until failure to determine ultimate load capacity and ultimate deflection, two were tested at low fatigue, and two were tested at high fatigue. The low fatigue tests varied the applied loading cyclically from approximately 30%-60% of maximum load capacity and the high fatigue tests varied the loading from approximately 40%-80% of maximum load capacity. The fatigue cycles were continued until beam failure or 1.2 million cycles. A LabViewÂ® program was used to enable test-control and data-acquisition for the specialized type of flexural fatigue testing.

The fiber mixes performed similarly to the plain concrete control specimens except that the fiber reinforced beams failed in a more ductile manner. The rate of flexural stiffness degradation was slightly greater in the fiber reinforced specimens. The more rapid degradation may have been caused by lower strength concrete in the fiber reinforced beams instead of the addition of the fibers.