GFRP Bar Transverse Coefficient of Thermal Expansion Effects on Concrete Cover

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In recent years interest in glass fiber reinforced polymer (GFRP) bars has increased and the bars are proving to be an effective alternative to steel reinforcing bars. As opposed to steel, GFRP bars are not subject to corrosion caused by deicing chemicals giving them an increased service life in many applications such as bridge decks, marine structures, and other environments where exposure to chlorides is extreme. GFRP bars also have a higher tensile strength than that of steel. These properties combined make GFRP bars good for top mat reinforcing of bridge decks where exposure to deicing chemicals is severe. However, previous research has shown that GFRP bars have a much higher coefficient of thermal expansion in the transverse direction than that of steel. Steel has a coefficient of thermal expansion roughly equal to that of concrete. With a high coefficient of thermal expansion for GFRP bars, thermal loading could crack the concrete cover and lead to spalling if sufficient confinement is not provided.

This research involved an investigation into the effects of GFRP bars with higher transverse coefficients of thermal expansion than concrete. The transverse coefficient of thermal expansion in the GFRP bars was measured for temperature ranges typical of that observed in bridge decks. GFRP bars were also cast into concrete cylinders of varying diameters and subjected to increases in temperature. The temperature at which internal cracking was detected in the cylinders was then compared to predictions by an analytical model.