

Flexural behavior of prestressed precast hollow core slabs strengthened with CFRP sheets

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Abstract

Precast prestressed hollow core slabs are one of the most commonly used structural systems to cover large spans. Primarily used as floor or roof system in the building industry, hollow core slabs also have application as wall panels, spandrel members and bridge deck units. Strengthening of these slabs may be required for several reasons. The main reasons include, increased load due to higher dead or live loads, architectural modifications in locations of walls, damage due to corrosion, installation of heavy machinery, or opening cut through slabs and errors in planning or construction due to insufficient design dimensions or insufficient reinforcing steel.

Nine full scale hollow core slabs (5.0 m span, 1.2 m width and 0.2 m thickness) were used in the experimental program. Each slab had 44% voids and were pretensioned by four 7-wire steel strands of 12.7 mm diameter. The slabs were tested under flexure and shear using four point loading up to failure. One slab was tested as control slab for flexure and one slab as control for shear. The remaining seven slabs were strengthened with CFRP sheets, including one damaged slab. The variables in the test program were the number of CFRP sheets. CFRP sheets of 0.3 m width and 0.13 mm thickness having a tensile strength of 3.45 Gpa and tensile modulus of 230 Gpa were used. Strain gauges and LVDT's were used to measure the concrete and CFRP strains and deflection profiles in each of the strengthened slabs.

Experimental results show that the flexural load carrying capacity of precast prestressed hollow core slabs was increased in the range of 14 to 36% depending on the number of CFRP sheets used. Interesting transition from flexural to shear failure was noted in the behavior of the panels as the number of CFRP sheets was increased, constraining any further increase in capacity. Mechanistic model was developed to predict the failure load of the slabs. A good correlations was observed between the experimental and the predicted values.