Flexural Behavior of Precast, Prestressed Hollow-Core Concrete Slabs Strengthened by CFRP

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This paper presents an experimental and numerical evaluation of flexural behaviour of one-way precast, prestressed hollow-core concrete slabs strengthened with carbon fibre reinforced plastic (CFRP). Eight full-scale hollow-core slabs 5.0 m long × 1.2 m wide × 0.2 m deep were tested under four-point loading. The slabs were simply supported on a span of 4.7 m and loaded so as to manifest a flexural failure. Three slabs were tested as control and the remaining five slabs were strengthened in flexure with CFRP sheets. The variables in the test programme include the ratio of area of CFRP sheets to concrete area, which ranged from 0.03 to 0.12%. The hollow-core slabs were modelled using the nonlinear finite element software DIANA and the load deflection behaviour and flexural capacity were evaluated numerically. For the FE model, the concrete was modelled using Drucker-Prager with tension cut-off failure criterion, and Von Mises plasticity with multilinear isotropic hardening was used to model the reinforcing strands. A comparison between the experimental and the numerical results indicated the validity of the computational model in capturing the experimentally determined response for load-deflection characteristics of the hollow-core slabs.