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عنوان البحث للأطروحة:

السلوك الانشائي للعتبة الهجينة المكونة من البلاطة الخرسانية مسبقة الصب والمقطع الانشائي البوليمري المسحوب المقوى بألياف الزجاج بشكل

"Structural Behavior of Hybrid Beam Composed of Precast Concrete Slab and Glass Fiber Reinforced Polymer Structural Pultruded I-Section"

عناوين البحوث المستلة:

1. Push-out Test on Shear Connectors in Normal Strength Concrete and GFRP Structural Pultruded I-Section
2. Flexural Behavior of GFRP-Concrete Hybrid Beams with High Strength Bolts and Drop-in Anchors Shear Connectors.

تقدير المناقشة: إمتياز

Structural Behavior of Hybrid Beam Composed of Precast Concrete Slab and Glass Fib er Reinforced Polymer Structural Pultruded I-Section

Abstract

This research presents an experimental and numerical study of the flexural behavior of hybrid beams composed of precast concrete slabs and structural pultruded glass fiber reinforced polymer (GFRP) I-sections.

The experimental program included the production and assembly of thirteen beams. The control reference beam was an I-shaped GFRP section of 304× 152×12.7 mm dimensions and 3000 mm total span. The other twelve were all composed of the same GFRP section with addition of precast concrete deck slab (with minimum reinforcement) that is 3000 mm long, 600 mm wide, and 100 mm thick. The two components were connected by shear connectors. The effect of three design variables on beams flexural behavior was studied. First one was the mechanism of shear connection, where three different types were used. They are (1) High strength bolts (HSBs) embedded in concrete; (2) drop-in anchors (with HSBs) also embedded in concrete; and (3) Post-grouted HSBs. The second variable was the spacing between connectors. A 300 mm and 400 mm spacing were used. The third variable was using an epoxy resin adhesive on contact surfaces of hybrid beams components. Hence, we have six pairs of hybrid beams, each two are similar in connector type and spacing (300 mm or 400 mm) but differ in using epoxy adhesive or not. The beams were tested (up to failure) in a four point static bending test through application of two symmetric concentrated loads at third points of beam span. Mid-span deflection, normal strains at mid-span (across beam depth) and under loading points, and ultimate failure loads were recorded during the test and till collapse. The testing results showed that the addition of concrete deck contributed to lighter distribution of compressive stresses on GFRP section top flange. This in turn utilizes more of the reserve in tensile strength of bottom flange that was not used when the GFRP section tested alone. Hence, a stiffer and stronger hybrid beam was achieved. The strength increases in the range of 68% to 143% compared to GFRP control beam. In addition, results show that the post-grouted HSB connection mechanism is the most efficient in developing composite action of hybrid beams, which results in a higher stiffness and flexural strength followed by the embedded HSB and lastly, the drop-in anchor. Also, it is concluded that using epoxy adhesive material on interface surfaces of hybrid beams components enhances the load capacity of tested beams by 15% to 20%. The predominant failure mode observed in eight of the twelve hybrid beams was the interlaminar shear mode, while three failed in bottom flange tension and one in compression (crushing) of top flange.

In the numerical part, ANSYS program (Release 15.0) with its two products Workbench and APDL was used in modeling and analysis of all the thirteen beams. The program uses the finite element method in solution of engineering problems. The analysis results are compared with their corresponding ones obtained from experimental testing. Comparisons show that a good agreement was achieved with an average of 102% for theoretical to experimental regarding the ultimate failure load.