Application of response surface methodology in finite element analysis of deflection of pretensioned inverted T-beam with web openings strengthened with GFRP laminates

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ABSTRACT
A precast, prestressed concrete girder with circular web openings allows building service systems (mechanical, electrical, communications, and plumbing) to cross the girder line within the memberpsilas depth, reducing a buildingpsilas floor-to-floor height and the overall height of the structure. These height reductions have the potential to improve the competitiveness of total precast concrete structures versus other types of building systems. The experimental program reported in this paper tested three inverted-tee girders with circular web openings strengthened with GFRP to failure to evaluate the openingspsila effect on girder behavior. The test girders were designed using available recommendations in the existing literature. Using ANSYS, finite element models were developed to simulate beam deflection behavior. Accuracy of the model is assessed by applying it to prestressed beam tested in this research. Comparison of analytical results with the available experimental results for load-deflection relationships show good agreement between the finite element and experimental results. Polynomial mathematical model, generated using various combination parameters using multiple regression analysis were found to be statistically significant. Parametric study using response surface methodology through finite element analysis may form efficient approximation to immediate deflection.

KEYWORDS
GFRP; Finite element; Prestressed inverted T- beam; Response surface; Web opening

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