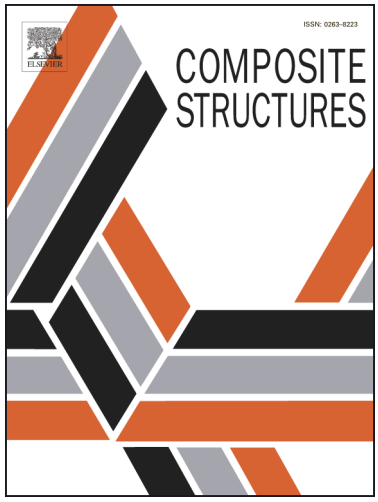

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Deformation Analysis of Fibre-Reinforced Polymer Reinforced Concrete Beams by Tension-Stiffening Approach

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Abstract: Fibre-reinforced polymer (FRP) is free from corrosion problem and is a viable alternative reinforcement material for concrete structures in lieu of steel reinforcing bars. Since FRP has lower elastic modulus compared to steel, the serviceability aspect of FRP reinforced concrete (FRP-RC) members should be particularly considered in the structural analysis and design. This study addresses the deformation analysis of FRP-RC flexural members with thorough consideration of the tension-stiffening phenomenon in post-cracking state. The approaches for analyzing the tension-stiffening flexural response of FRP-RC beams are presented. These include the use of empirical or theoretical models to compute effective flexural stiffness, the use of finite element method in conjunction with nonlinear constitutive material models, and the use of tensile stress block in combination with member analysis. Among them, the latter is a relatively simple analysis approach. Aiming for serviceability assessment of FRP-RC beams in structural engineering practice to circumvent sophisticated theoretical models and constitutive models, parametrized tensile stress block is derived based on tension stress fields computed from finite element analysis, and is proposed for use in member analysis for prediction of deflections. Four FRP-RC beam specimens tested in the literature are analyzed to verify the proposed tensile stress block. Close agreement between the experimental and analytical results is achieved, thereby endorsing the applicability and reliability of the proposed method.

Keywords: Deflection; fibre-reinforced polymer; finite element method; FRP reinforcement; member analysis; serviceability; tensile stress block; tension-stiffening.