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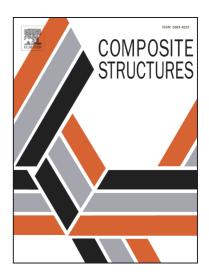
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CCEPTED MANUSCRIPT

EVALUATION ON MATERIAL BEHAVIORS OF PULTRUDED GLASS FIBER

REINFORCED POLYMER (GFRP) LAMINATES

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Abstract: In order to extend the use of pultruded glass fiber reinforced polymer (GFRP) composite

materials in civil engineering, a systematic study on pultruded GFRP laminate is important and

realistic for the design and construction of GFRP structures in bridge engineering. A practical method

to evaluate the fiber volume fractions and the equivalent thickness of each lamina is proposed

considering that a typical pultruded FRP profile is not truly laminated structure in rigorous sense. The

elastic modulus and ultimate strength of each lamina were predicted based on micromechanics. In

terms of that the facts that lack of knowledge of the majority of bridge engineers on the behavior of

composites, an innovative carpet plots with different fiber volume fraction are adopted to finish the

laminate design procedure without much complicated calculation. In addition, a continuum damage

model considering lamina shear nonlinearity, lamina damage along thickness direction, innovative

damage evaluation methods, loading/unloading strategy and viscous methods to alleviate the

convergence difficulties is proposed and implemented via user material subroutine. Three different

types of pultruded GFRP laminate were fabricated, and material properties have been tested to validate

the numerical and theoretical models. The Finite element simulation results agreed well with tests and

could provide reference for the design and construction of GFRP structures.

Keywords: Glass fiber reinforced polymers (GFRP); Laminates; Finite element analysis; Pultrusion

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