INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: WEB CRIPPLING BEHAVIOUR OF PULTRUDED GLASS FIBRE REINFORCED POLYMER WIDE FLANGE-SECTION PROFILES WITH WEB PERFORMATIONS

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Thesis Submitted to the Department/ Center	:	Civil Engineering

Date of completion of Thesis Viva-Voce Exam	:	29-06-2021
Key words for description of Thesis Work	:	Web Crippling, Pultruded Glass Fibre Reinforced Polymer, Wide Flange Section, Perforation

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An increasing use of Glass Fibre Reinforced Polymer (GFRP) pultruded structural profiles has been seen in the recent past as an alternative option to traditional structural members, made of materials such as steel, concrete, aluminium etc. owing to their numerous advantages such as high strength to weight ratio, corrosion resistance, lower maintenance cost, easy installation process etc. However, limited research has been seen in GFRP structural members when subjected to web crippling load for both unperforated and perforated GFRP profiles. Additionally, in the Indian context, limited technical test data of the GFRP materials are available in the public domain and there are no Indian standards for recommending design or test procedures for these GFRP materials or members. Hence, in this thesis, an attempt has been made to characterize a type of GFRP manufactured in India, followed by investigations into the web crippling behaviour of GFRP wide flange (WF)–section profile for both perforated and unperforated cases.

Initially, an investigation on the mechanical properties has been assessed for six different GFRP profile shapes and sizes by conducting tensile, compression, interlaminar shear and in-plane shear tests that are performed on coupons obtained from the flanges and webs of the profiles, and their characteristic material properties are evaluated. Following this, a comparative study has been performed on the material partial safety factors and conversion factors and subsequent design values by considering four design guidelines (Italian guideline, 2007; ASCE, 2010; EUROCOMP, 1996; and Ascione *et al*., 2016).

Second, an investigation on the web crippling behaviour of unperforated GFRP profile has been performed by utilising a GFRP wide flange (WF)–section profile. The study investigates systematically the effects of bearing lengths and plate thickness on the web crippling behaviour of the GFRP profile. Both experimental and numerical investigations have been performed by considering two loading configurations such as end-two-flange (ETF) and interior-two-flange (ITF) loadings. Bearing length is found to have direct influence on the web crippling strength and behavior of the GFRP profile. Based on the combined test data from the current experimental campaign and data from literature, new design equations have been proposed for both ETF and ITF loading configurations.

Finally, the effects of centred circular web perforations of different sizes on the web crippling behaviour of GFRP WF-section profile, under ETF and ITF loadings, have been studied experimentally and numerically. Based on parametric study, it has been observed that the ultimate crippling strength of the GFRP profile is significantly influenced by the bearing plate length to web height ratio and the perforation diameter to web height ratios. Further, on the basis of both experimental and numerical results, reliable web crippling strength reduction factor equations are proposed.