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NON-LINEAR ANALYSIS OF STEEL-CONCRETE BEAMS USING GENERALIZED BEAM THEORY

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The Generalized Beam Theory (GBT), first proposed by Schardt [1], may be viewed as an extension of Vlasov's prismatic bar theory that takes into account cross-section in-plane and out-of-plane (warping) deformation through the consideration of pre-determined "cross-section deformation modes", whose amplitudes along the beam axis constitute the only problem unknowns. It has been widely demonstrated that GBT constitutes a powerful, elegant and clarifying tool to solve a wide range of structural problems involving prismatic thin-walled members (e.g., [2]).

Recently, in the field of steel-concrete composite bridge linear analyses, very promising results have been obtained with GBT, due to its straightforward capability of including shear-lag and shear connection flexibility effects [3]. In addition, elastoplastic GBT formulations (either geometrically linear or non-linear) have also been developed [4, 5]. In this paper, an extension of these previous formulations is presented, which aims at modelling the materially non-linear behaviour of steel-concrete composite beams. In particular, a GBT-based finite element is presented, which incorporates (i) reinforced concrete non-linear behaviour, (ii) shear-lag effects and (iii) steel beam plasticity. Several illustrative examples are presented and discussed. For validation and comparison purposes, results obtained with shell/solid finite element models are provided.

REFERENCES

[1] R. Schardt. *Verallgemeinerte Technische Biegetheorie*, Springer-Verlag, 1989. (in German)

[2] D. Camotim, C. Basaglia, R. Bebiano, R. Gonçalves and N. Silvestre. Latest developments in the GBT analysis of thin-walled steel structures. *Proc. Int. Coll. Stability and Ductility of Steel Struct.*, Rio de Janeiro, Brazil, E. Batista, P. Vellasco and L. Lima (eds.), 33–58, 2010.

[3] R. Gonçalves and D. Camotim. Steel-concrete composite bridge analysis using Generalised Beam Theory. *Steel and Composite Structures*, Vol. **10**(3), 223–243, 2010.

[4] R. Gonçalves and D. Camotim. GBT-based Finite Elements for Elastoplastic Thin-Walled Metal Members. *Thin-Walled Structures*, Vol. **49**(10), 1237–1245, 2011.

[5] R. Gonçalves and D. Camotim. Geometrically Non-Linear Generalised Beam Theory for Elastoplastic Thin-Walled Metal Members. *Thin-Walled Structures*, Vol. **51**, 121–129, 2012.