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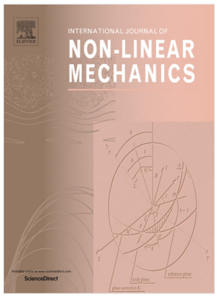

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Md. Alhaz Uddin, Abdul Hamid Sheikh, David Brown, Terry Bennett, Brian Uy

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Geometrically nonlinear inelastic analysis of steel-concrete composite beams with partial interaction using a higher-order beam theory

Md. Alhaz Uddin[a], Abdul Hamid Sheikh[a,*], David Brown[a], Terry Bennett[a] and Brian Uy[b]

[a] *School of Civil, Environmental and Mining Engineering, The University of Adelaide, Adelaide, SA 5005, Australia*

[b] *School of Civil Engineering, The University of Sydney, Sydney, NSW 2006, Australia*

ABSTRACT

A comprehensive finite element model based on a higher-order beam theory (HBT) is developed for an accurate prediction of the response of steel-concrete composite beams with partial shear interaction. The formulation of the proposed one dimensional finite element model incorporated nonlinearities due to large deformations of the beam as well as inelastic material behaviour of its constituent components. The higher-order beam model is achieved by taking a third order variation of the longitudinal displacement over the beam depth for the steel and concrete layers separately. The deformable shear studs used for connecting the concrete slab with the steel girder are modelled as distributed shear springs along the interface between these two material layers. The Green-Lagrange strain vector is used to capture the effect of geometric nonlinearity due to large deflections. The von Mises plasticity theory with an isotropic hardening rule and a damage mechanics model are incorporated within the proposed finite element model for simulating the inelastic response of the beam materials. The nonlinear governing equations are solved by an incremental-iterative technique following the Newton-Raphson method. A dissipation based arc-length method is employed to capture the post peak response of these beams successfully. The capability of the proposed model is assessed through its validation and verification using existing experimental results and numerical results produced by detailed finite element modelling of these beams.

* Corresponding author:
Email: abdul.sheikh@adelaide.edu.au

Tel: +61-8-8313-6450; Fax: +61-8-8313-4359