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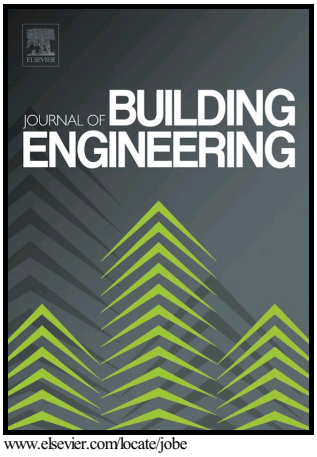

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Isabella Giorgia Colombo, Matteo Colombo, Marco di Prisco and Farhang Pouyaei

Politecnico di Milano – Department of Civil and Environmental Engineering

Phone: +39 02 2399 8790 Fax: +39 02 2399 8771 URL: www. polimi.it

@ isabellagiorgia.colombo@polimi.it; matteo.colombo@polimi.it; marco.diprisco@polimi.it; farhangpye@gmail.com

Abstract

This paper concerns the investigation of the behaviour of sandwich beams previously tested in four point bending through analytical and numerical models. Modelling is a fundamental resource to predict the mechanical response of the element and to investigate the mechanisms that act during the evolution of the test.

The sandwich beams here taken into account are characterised by external textile reinforced concrete (TRC) layers and an insulation material (expanded polystyrene, EPS) able to transfer shear stresses. Bond between the layers is obtained during production thanks to an in-pressure casting technique, and no particular device is used in order to transfer shear stresses between the layers. Two beam slenderness values are taken into account.

An analytical and a numerical approach have been used in order to predict the experimental behaviour: concerning the analytical approach, a model based on the Stamm and Witte sandwich theory has been developed including material non-linearity; concerning the numerical analysis, a finite element (FE) model has been built in ABAQUS including material and geometry non-linearity. The assumption of perfect bond is used in both cases.

The non-linear analytical and finite element models have been validated, as a good agreement with experimental results has been achieved. The experimental identification of material parameters - TRC in tension, mortar in compression and EPS in tension, compression and shear - is crucial for the definition of proper constitutive laws for the models and is here presented and discussed. For both approaches, the assumptions of modelling TRC in bending as homogeneous and assuming perfect bond between TRC and EPS (even when behaviour becomes highly non-linear) have been proved to be reliable. Analytical and FEM results show that EPS non-linear behaviour and TRC membrane and bending behaviour govern the response. The FE analysis also highlights the mechanisms involved in specimen failure.

Textile reinforced concrete (TRC); sandwich beam; four-point bending test; non-linear analytical model; finite element method.