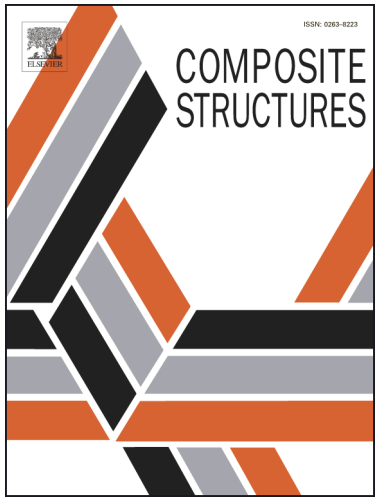

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Modelling of Glulam beams pre-stressed by compressed wood

B. Anshari[1], Z.W. Guan*[2,3] and Q.Y. Wang[3]

[1]Department of Civil Engineering, University of Mataram, NTB, Indonesia.

[2]School of Engineering, University of Liverpool, Liverpool L69 3GQ, U.K

[3]School of Mechanical Engineering, Chengdu University, Chengdu 610106, China

Abstract

Finite element models were, in the first time, developed to simulate the pre-stressing behaviour of Glulam beams with insertion of compressed wood blocks, which were further used to simulate the structural behaviour of the pre-stressed beams subjected to subsequent destructive bending. Here, both the Glulam and compressed wood were modelled as orthotropic elasto-viscoplastic materials. The moisture-dependent, including spring back, swelling of the compressed wood block and the creep of the Glulam were considered in the modelling. The models developed were validated against the corresponding experimental results, with reasonably good correlation in terms of the free swelling, the precamber, initial stress state of the Glulam beams reinforced and load-deflection relationships. With validated models, further studies were then undertaken to investigate effects of the thickness, depth and spacing of compressed wood blocks on the precamber, initial bending stiffness and ultimate load carrying capacity of the beams pre-stressed. The results indicate that there are significant enhancements on the precamber (up to 1/288 of the deflection/span ratio), the initial bending stiffness (up to 23.8 %) and the ultimate load carrying capacity (up to 10.4 %).

Keywords: moisture-dependent swelling, Glulam beam, compressed wood, finite element, pre-stressing, visco-plasticity

1. Introduction

Reasonable amount of work has been carried out on numerical modelling of mechano-sorptive process in wood and strengthened Glulam beams in the past 3 decades. Research on modelling of moisture movement in wood was undertaken by Koponen et al. [1] to model elastic and shrinkage properties of cell wood structures. Ormarsson et al. [2] developed modelling of the long-term strength and shape stability of