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Dimensional optimization of carbon-epoxy bars for reinforcement of wood beams

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Abstract

In this work, experimental and numerical studies of wood beams reinforced with an embedded bar of carbon-fibre reinforced polymer were performed. The beams were submitted to three-point bending loading considering three different heights of embedded systems. The experimental load-displacement curves were used to validate a numerical model based on three-dimensional finite element analysis including cohesive zone modelling and plastic behaviour of wood. Different cohesive laws were assumed to mimic several failure modes observed experimentally, as is the case of composite-wood members debonding and transverse fracture of the whole beam. Subsequently, the model was used in several numerical analyses aiming the optimization of the reinforcing bar dimensions considering a constant volume fraction. The objective was to achieve the maximum reinforced beam strength under bending. It was concluded that the best solution consists of using a thin external reinforcement constituted by four layers of carbon-epoxy unidirectional laminate.

Keywords: A. Wood; B. Debonding; B. Transverse Cracking; C. Finite element analysis (FEA), Cohesive zone model.

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