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Lateral Torsional Buckling: Tests on Glued Laminated Timber Beams

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Abstract : Glued laminated timber (glulam) is a preferred choice for long span girders, e.g., for gyms or storage halls. While the material provides sufficient strength to resist the bending moments, large spans lead to increased slenderness of such members and to a higher susceptibility to stability issues, in particular to lateral torsional buckling (LTB). Rules for the determination of the ultimate LTB resistance are provided by Eurocode 5. The verifications of the resistance may be performed using the so called equivalent member method or by means of theory 2nd order calculations (direct method), considering equivalent imperfections. Both methods have significant limitations concerning their applicability; the equivalent member method is limited to rather simple cases; the direct method is missing detailed provisions regarding imperfections and requirements for numerical modeling. In this paper, the results of a test series on slender glulam beams in three- and four-point bending are presented. The tests were performed in an innovative, newly developed testing rig, allowing for a very precise definition of loading and boundary conditions. The load was introduced by a hydraulic jack, which follows the lateral deformation of the beam by means of a servo-controller, coupled with the tested member and keeping the load direction vertically. The deformation-controlled tests allowed for the identification of the ultimate limit state (governed by elastic stability) and the corresponding deformations. Prior to the tests, the structural and geometrical imperfections were determined and used later in the numerical models. After the stability tests, the nearly undamaged members were tested again in pure bending until reaching the ultimate moment resistance of the cross-section. These results, accompanied by numerical studies, were compared to resistance values obtained using both methods according to Eurocode 5.

Keywords : experimental tests, glued laminated timber, lateral torsional buckling, numerical simulation
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