DYNAMIC BEHAVIOR OF TIMBER BEAMS WITH UNCERTAIN PROPERTIES

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ABSTRACT

Wood is employed in a great variety of structures such as bridges and poles in electrical distribution networks. Knots, oblique fiber orientation and other grown defects lead to non-homogeneities of the modulus of elasticity, the stiffness, the mass density, etc. A stochastic model with random variables and fields is a useful approach to study the behavior of timber structures, such as beams and columns. The governing equations are discretized by means of the Stochastic Finite Element Method [1]. The Principle of Maximum Entropy is employed to find the most appropriate Probability Density Function. Tools such as Nataf transformation, non-Gaussian Karhunen-Loeve expansion and Monte Carlo Simulations [2] are used to generate and simulate the random fields. First, the elastic deformation in sawn beams of Argentinean Eucalyptus grandis with uncertain properties is studied. The influence of the lengthwise variability of the Modulus of Elasticity (MOE) represented by a random field is assessed and a reliability study is also carried out. The MOE variability and the presence of knots assumed randomly shaped, sized and located are considered to tackle the static buckling problem of a column with geometric and material uncertainties. Also, the natural vibration case of a timber beam is evaluated under similar conditions. Additionally, the forced response of timber beams is analyzed. A Timoshenko beam model is stated using a complex stiffness for both bending and shear deformations. This material model leads to hysteretic damping [3]. The loss factors are also considered random. The presence of knots, variability of mass density, damping and lengthwise MOE in sawn timber structures are frequently disregarded, usually due to the lack of data and the availability of an adequate representation. The present approach contributes to attain a more realistic description of the problem.

REFERENCES

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