

DEVELOPMENT OF A 3D VISCO-ELASTIC MODEL FOR WOOD UNDER LARGE DEFORMATIONS

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Some of the most frequently observed phenomena in structural materials are creep and relaxation. Both are associated with time-dependent behavior and dissipative rheological variables. In the case of wood, long-term creep can produce excessive deformation and instability problems by magnifying short-term deflections [1]. Also, wood presents changes in its mechanical properties due to its hygroscopy, so that moisture appears as an important parameter to be considered. A priori, it is known that the moisture content in wood cells and the angle of microfibrils are parameters that directly affect the overall cell stiffness. With this information, material physics hypotheses can be elaborated to develop a constitutive model in large deformations to predict phenomena such as creep and relaxation in the medium and/or long term. In the context of continuum mechanics, visco-elastic behavior can be modeled by a rheological model of springs, which represent the reversible character, and dashpots, which represent the viscous (inelastic) behavior. The classical treatment of the constitutive equation considers the use of viscous stress or strains as internal variables. In this study, this kind constitutive model is adapted to include both environmental factors, such as humidity and temperature, and microstructural parameters, such as the microfibril angle. A numerical analysis of the equations, such as thermodynamics consistency (verification of the Clausius-Duhem inequality) and incremental objectivity (frame-indifference) are discussed, aiming to efficiently implement the model as an external material subroutine for commercial finite element softwares.

REFERENCES

- [1] Tissaoui, J. (1996). Effects of Long-Term Creep on the Integrity of Modern Wood Structures [PhD thesis, Virginia Tech]. <https://vtechworks.lib.vt.edu/handle/10919/30288>