EXPERIMENTAL STUDY OF THE BENDING CREEP PROPERTIES OF OAK AND NORWAY SPRUCE

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In Europe, industries from construction and furniture sectors are exploring the possibility of using hardwoods for wood load-bearing products [1]. Hardwoods have typically better mechanical properties because of their higher densities compared to softwoods [2]. An aspect that now raises a concern from these sectors is the creep behaviour of the two wood classes, under bending. Creep means that deformations gradually increase under a constant load occurring over a long period of time.

In this project, the aim is to study experimentally the creep behaviour of Oak (hardwood) and Norway spruce (softwood) under bending in the same standard climate conditions (65% of relative humidity and 20 °C). For the tests, an experimental protocol has been designed as shown in Fig. 1: (1) timber boards were purchased and (2) twin samples for each material were cut from the same board. One of the twin samples are tested under (3) static four-point bending for measuring the bending strength, and their pairs are tested in (4) a bending creep rig. Knowing accurately the bending strength prior the creep tests is important to determine the weights in the creep rig for desired stress levels. The creep properties in this project will be referred to 25 and 50 per cent of the bending strength. At stresses lower than 50 per cent of the strength the wood is assumed to behave linear in creep [2].

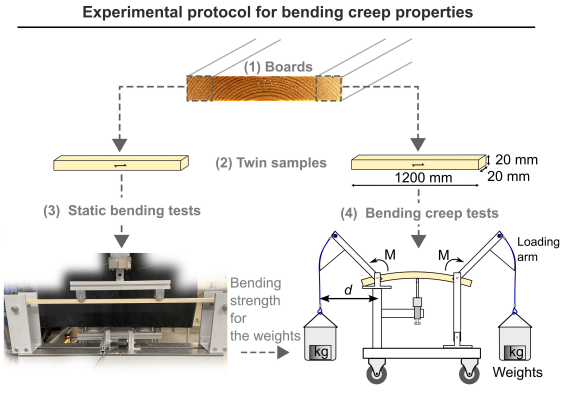

Figure 1: Scheme to show the experimental protocol to measure bending creep properties of wood.

The bending creep rig was originally developed by Prof. Hoffmeyer [3] and has a special scythe-like shape at the ends of loading arms. The ingenious shape makes the horizontal distance d between the supports and the weights constant, implying a constant moment M over the elapsed time.

In the presentation, we will discuss the experimental protocol and the results from the two wood species tested. Also, more details will be discussed about the interesting creep rig and its upgrades from the original design. For creep tests, the main objective is to find the constitutive relation between the creep strain $\varepsilon(t)$ and the constant stress σ_0 described as

$$\varepsilon(t) = J(t)\sigma_0, \tag{1}$$

where $J(t)$ is the creep compliance.

With the creep data from this work, we expect to provide a guidance for a suitable viscoelastic model for structural timber design as no consensus exists and different functions for the creep compliance can be found in the literature. It spans from simple power-law models to various rheological viscoelastic models with different arrangements of springs and dashpots.

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References

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