VISCOELASTIC CREEP OF WOOD: DEVICE AND MEASUREMENT

INTRODUCTION

During the last decades, many rheological material models for predicting wood viscoelastic behavior were developed. Most of them are derived from the compliance curves, which result from creep measurements. To achieve the comprehensive rheological material model of creep, it is necessary to measure both tensile and compressive creep of wood, obviously for all the wood directions – longitudinal, radial and tangential. The process of obtaining creep material characteristics is not as easy as obtaining other material characteristics of wood (for example Young's moduli, Poisson's ratios for linear elastic material models). The measurement of long-term creep strain is very time consuming and sensitive to relative humidity and temperature changes as well as to possible load changes during the measured period. This is the reason why the compliance curves for common European wood species are not usually available or if they are, usually not for the same loading levels or climatic conditions in all wood directions. This lack of data resources for our material models has led to the development of the device for measurement of creep material characteristics and its use for the complex description of Spruce (*Picea abies* L.) wood creep under uniform conditions (RH, T, loading level).

MATERIALS AND METHODS

Common testing machines, which are usually used for the experimental evaluation of the time independent material characteristics are not able to hold constant force on the specimen during longer time periods because of its nature. The easiest way to reach the constant force on the specimen is to load it by a hanging weight. For loading the specimens by 50 % of the yield strength, the maximal loading weights (compressive test in longitudinal direction) are approximately 400 kg. This led to the decision to use a load multiplicator – hydraulic press.
Smaller cylinder is carrying the weight while the bigger cylinder is tensile loading the specimen. For compressive test, the reverse jaws are used to transform the tensile load to the compressive one. The force ratio between the cylinders is 3,5. A frame for holding the smaller hydraulic cylinder with weights was constructed and built. A frame of commonly used testing machine Tinius Olsen 10ST was used to hold the bigger cylinder and loaded specimen. The testing machine is equipped by a conditioning chamber which is used for conditioning to 50 % of RH and the temperature of 20°C. To verify the constant force on the specimen, the oil pressure sensor was installed into the hydraulic circuit, because the common tensiometers reported significant errors during long-term tests.
The uniaxial creep deformation (elongation/shortening) of the specimen is observed by a camera (1 frame per minute). The analysis of the creep strain field is realized using 2-D digital image correlation – by a tracking of isolated points.
The strain data (compliance curves) from the DIC analysis are processed in MATLAB and fitted on the model curves and then used for the modeling of creep. Parameters of the creep tests which are realized during these days are stated in table below.

Figure 1 Creep testing kit

Table 1 Parameters of the creep tests

	Tensile test			Compressive test		
Direction	L	R	T	L	R	T
Yield Strength [MPa]	75	2,2	1,7	21	3,4	4
50 % Y.S. [MPa]	37,5	1,1	0,85	10,5	1,7	2
Cross section [mm^2]	100	600	600	400	600	600
Applied force [N]	3823	673	520	4281	1040	1223
Weight on small cylinder [kg]	109	19	15	122	30	35

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