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# STRUCTURE –PROERTY RELATIONSHIPS – A STUDY ON THE GROWTH RING SCALE OF NORWAY SPRUCE

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The growth ring structure of softwoods with its alternating earlywood and latewood bands is well-known. In this study, the structure-property relationships within growth rings of Norway spruce (*Picea abies* (L.) Karst.) are investigated. The use of SilviScan® and electron microscopy shows the great intra-ring variability of density and microfibril angle as well as cross-sectional cell dimensions. This variability is reflected in the full-field moisture-induced deformation within the hygroscopic range as determined by digital image correlation. Whereas radial swelling closely follows the density distribution within the growth ring with the highest deformation in the dense latewood, the corresponding tangential deformation is constant throughout a growth ring in the boundary-unaffected region of the sample. The application of a simple FEM model and the selective activation of the different tissues shows that radial swelling basically is dominated by earlywood, whereas tangential swelling is a complex interaction of expansion and contraction and needs the contribution of all tissues to fully develop. This behavior is reflected in the swelling of macroscopic samples with varying growth-ring widths and therefore varying portions of early- and latewood. In order to analyze local moisture concentration, neutron imaging (NI) and digital image correlation (DIC) were combined. This combination enables the calculation of volumetric as well as gravimetric moisture content. Whereas the former closely follows density distribution with the highest volumetric concentrations in latewood, the latter basically is constant throughout the growth ring.