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MULTISCALE APPORACH FROM MICROMECHANICS UP TOWARDS CREEPING WOOD STRUCTURES

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Old and culturally valuable wooden structures undergo creep deformation during decades or even centuries. To preserve these structures for future generations, it is necessary to measure the increasing deformation with the aim to predict the overall creep. It would then be possible to engineer a support structure to mitigate further creep, and minimize the risk of structural failure. Due to the general complexity and interacting length scales, it must be carefully assessed which mechanisms should be included in the model and which length scales. An engineering top-down approach is a natural starting point. It is however rarely possible to test larger archeological wood elements mechanically, since this can induce damage and necessitates partial dismantling of the structure. Instead, the constitutive behavior can be characterized on small samples that can be spared. Up-scaling from the mechanical behavior of the material specimens to the structural response requires assessment of the effects of variation in density, grain orientation and wood treatment. A micromechanical model can be helpful in the scaling up from samples to beams. The next step upwards is to include the effects of joint movement, which could in principle contribute in the same order of magnitude as the material creep. Four length scales can be identified: Microstructure – material – members and joints – structure. Supporting measurements can be made on each of these scales, which would improve the reliability of the predictive model. Although prediction for large structure is the goal, there is a role of micromechanics is addressing the natural variability of constitutive wood material. An example is presented for the 17th century warship Vasa. The generalized approach is also considered to be applicable to other aging wood structures.