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INTEGRATED APPROACH FOR MODELING POST-TENSION LOSS IN MASS-TIMBER PANEL BUILDINGS

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Mass-timber panels (MTP) such as cross-laminated timber are engineered wood products that enable the construction of mid- and high-rise timber buildings. In North America, 2021 International Building Code (IBC) approves mass timber structures up to 18 stories tall [1]. The code stipulates provisions for seismic designs aimed primarily at preventing loss of lives, even as structures are allowed to sustain seismic damage beyond repair leading to decomission. Reduction costly seismic damage to levels allowing timely repair and post-event re-occupancy is a subject of new design techniques following the resilient low-damage design principle. One of such techniques proposed for mass-timber panel structures is low-damage lateral force resisting system relying on a self-centering mechanism facilitated by post-tensioned steel tendons fitted on shear walls. The system allows the walls substantial rocking movement during the seismic event but restores proper position immediately after the event. Its effectiveness relies on the PT load in the tendons remaining at the prescribed level until the seismic event. However, data from monitored operative PT timber buildings show PT losses at rates beyond expected levels. The long-term mechanical response MTPs to in-plane PT loads is a complex, multi-physics problem involving moisture sorption, diffusion, constrained hygroexpansion, as well as viscoelastic and mechano-sorptive response. Since both the PT load and panel dimension change with time the problem cannot be simplified to a clear creep or relaxation case. The goal of the presented project is to use an integrated experimental and modelling approach leading to a reliable 3D multi-physical numerical model for predicting long-term PT loss in MTP structures exposed to loads under variable climate conditions. The general approach is to refine the model using data from tests conducted at a material, element and assembly level and use homogenization schemes when transitioning between scales. The presentation will include the conceptual framework of the project and preliminary results.

REFERENCE

[1] International Code Council (ICC). 2021 International Building Code. 2020. ISBN: 978-1-

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