

When is a Proper Time to Change Something in the Wooden Facade? Defining Limit States and User Preferences

Jakub Sandak^{1,2,3}, Anna Sandak^{1,3}, Agnieszka Landowska⁴, Veronika Kotradyova⁵, Marcin Brzezicki⁶, Marta Petrillo³, Paolo Grossi³

¹InnoRenew CoE, Livade 6, 6310 Izola, Slovenia

²University of Primorska, Andrej Marušič Institute, Muzejski trg 2; SI-6000 Koper, Slovenia

³Trees and Timber Institute CNR-IVALSA, via Biasi 75, 38010 San Michele all'Adige, Italy

⁴Gdansk University of Technology, Faculty of Electronics, Telecommunications and Informatics, ul. Narutowicza 11/12, 80-233 Gdansk, Poland

⁵Slovak University of Technology, Faculty of Architecture, Námestie slobody 19, 81245 Bratislava, Slovakia

⁶Wroclaw University of Science and Technology, Faculty of Architecture, ul. Prusa 53/55, 50-317 Wroclaw, Poland

jakub.sandak@innorenew.eu

anna.sandak@ivalsa.cnr.it

nailie@eti.pg.gda.pl

kotradyova@fa.stuba.sk

marcin.brzezicki@pwr.edu.pl

petrillo@ivalsa.cnr.it

grossi@ivalsa.cnr.it

Abstract

In the times of a great technological development, timber become yet again recognized by the modern society as a highly valuable resource for constructing. Wood possess several assets making it perceived as a “friendly” and “natural” material, with majority of people declaring very positive impressions when interacting with it in surrounding. Unfortunately, wood as any biological material slowly degrades during its service life due to biotic and abiotic factors. The kinetics of such degradation differs depending on the function, exposure to degrading agents or on the maintenance activities. In any case, a continuous progress of the appeal loss is unavoidable. It significantly affects the human perception of that product and may result in very different user emotions than these at the “brand new state”. In majority of cases, the decision to replace or remove bases therefore not on the loss of functionality but on the aesthetics. At the same time, it is not clear to what extend the decision is affected by other factors, such as cultural circumstances, education level, environmental awareness or economic efforts related to the mitigation action. Determination of the factual limit state for aesthetical appreciation of the changes to wood is fundamental for a proper scheduling of the cleaning,

maintenance and/or replacement operations. It also affects a real service life duration, actual service life cost and overall environmental impact.

For that reason, a systematic research was performed by the multidisciplinary team with a focus on the systematic studies on the human tolerance for aesthetic changes of the building facades made of biomaterials. Different methods for interaction with users were tested, including interviews, questionnaires and interaction with selected physical samples. Custom multimedia software tools, as well as measurement of physiological responses (EEG, heartbeat, skin impedance among the others) were also investigated as an alternative to classical methods. All the results were analysed from different perspectives, including architects (form, beauty, tectonics, rhythm), psychologists (feelings, stress, appreciation), wood technologists (material state, surface properties, degradation mechanisms, weather doses) and software engineers (multivariate data analysis, numerical models linking objective measurements and human feelings).

All the experiences acquired were used to develop an original software tool simulating the change of façade appearance in the building by considering diverse materials and local circumstances (microclimate, solar exposure, architectural details, etc.). The software allows determination of the personalized aesthetical limit state defined on the base of the building outlook simulation, supplemented with a set of additional information. These include actual service life costing and environmental impact estimated according to the customized frequency of maintenance operations.

Keywords:

wooden façade, weathering, appearance, aesthetics, service life, limit state, user preferences