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From digital model to living surface: BIM-informed microbiome mapping on wooden buildings

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This study explores the intersection of building science and microbiology by using Building Information Modelling (BIM) to guide microbial mapping on a wooden structure. BIM is a tool for exposure dose mapping developed for the WoodLCC demonstration house, incorporating material properties, design detailing and weather exposure data including solar radiation, temperature, and moisture from rainfall and humidity. The resulting BIM-based map identified most vulnerable areas to environmental stress and potential decay. Based on these insights, representative sites were selected for microbial sampling, encompassing a variety of orientations, exposure levels, and protective conditions. Swabs collected from these locations were analysed to assess microbial colonisation and its potential role in the degradation or protection of spruce wood. By correlating environmental exposure with microbial presence, bioreceptivity of investigated surfaces, and wood decay, the study provides a deeper understanding of wood durability in outdoor conditions. This interdisciplinary approach highlights how digital tools like BIM can inform biological investigations, ultimately supporting the development of more sustainable and resilient timber construction through targeted protective strategies. This research also forms a foundational step toward the goals of the ARCHI-SKIN project, which aims to develop a living coating system based on Engineered Living Materials (ELMs). It is based on a technically applicable, controlled, and optimised fungal biofilm that can effectively protect various building surfaces. By understanding how natural microbial communities interact with environmental stressors and wood substrates, we can inform the design of engineered biofilms that not only enhance service life performance but also enable functionalities such as self-healing, moisture regulation, and surface renewal. The integration of BIM with microbiome analysis opens new possibilities for adaptive, biologically augmented building facades in sustainable architecture.

Keywords: BIM, bioreceptivity, microbiome, living coatings, biofilm, ELMs

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