

Transforming Reclaimed Wood into Graded-Transparent 3D-Printed Biocomposites for Architectural Applications

Developing sustainable, transparent building materials through innovative 3D printing

The project "Transforming Reclaimed Wood into Graded-Transparent 3D-Printed Biocomposites for Architectural Applications" aims to develop an innovative and sustainable building material. Reclaimed wood waste will be converted into a 3D-printed biocomposite with optical transparency and self-supporting properties. Intended for non-structural architectural applications, such as façades and interior spaces, the material offers a low-carbon alternative to energy-intensive glass while adhering to circular economy principles.

The biocomposite combines modified reclaimed wood fibres and gum rosin as a binder, optimised to achieve optical transparency, mechanical durability, and printability. A novel Functionally Graded Deposition Modelling (FGDM) process will enable the blending of transparent and opaque materials to produce components with spatially controlled transparency tailored for architectural applications.

The project involves two main interconnected phases. Material development focuses on enhancing the composition of reclaimed wood and lignin to achieve transparency, strength, and durability. In parallel, 3D printing innovation is driven by the design of a custom extrusion system capable of producing components with graded transparency. A large-scale architectural demonstrator will finally be fabricated to showcase the material's aesthetic and functional capabilities in real-world applications.

Scheduled to run from March 2025 to August 2026, the project is conducted by SDU CREATE at the University of Southern Denmark and the University of Copenhagen (UCPH-BioCAT). SDU CREATE specialises in computational design and advanced 3D printing techniques, with Postdoctoral Researcher Giulia Pelliccia, supervised by Associate Professor Roberto Naboni, leading the 3D printing innovation. UCPH-BioCAT, within the Department of Geosciences and Natural Resource Management, focuses on bio-based material development, led by Postdoctoral Researcher Julian Christ under the supervision of Associate Professor Emil Englund Thybring.

This research addresses the environmental challenges associated with traditional architectural materials. By transforming wood waste into a functional, transparent material, the project aims to reduce carbon emissions while enabling flexible, energy-efficient, and customisable design solutions. The outcomes will include scientific publications and presentations at international conferences. A large-scale demonstrator will be exhibited at SDU CREATE to showcase the material's architectural and functional potential, highlighting its contribution to sustainable construction and its capacity to inspire future building practices.