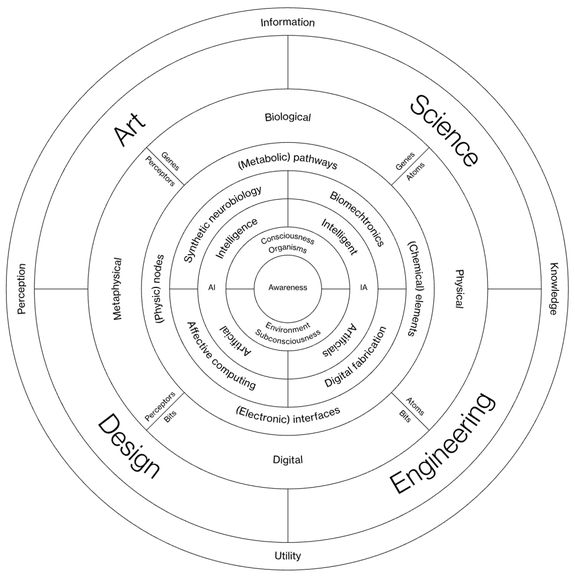
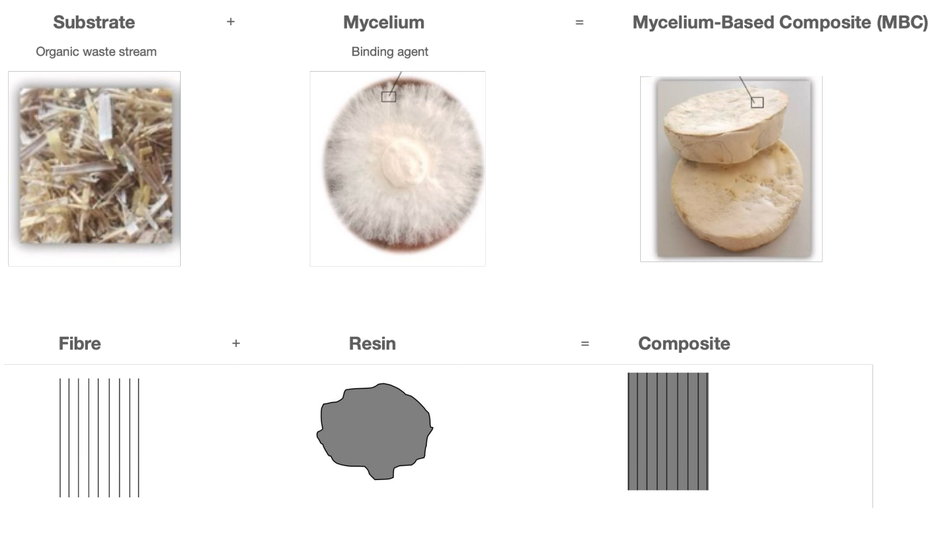
DESIGNING GROWN BIO- STRUCTURES

Textile Reinforced Mycelium- Based Composites

Introduction



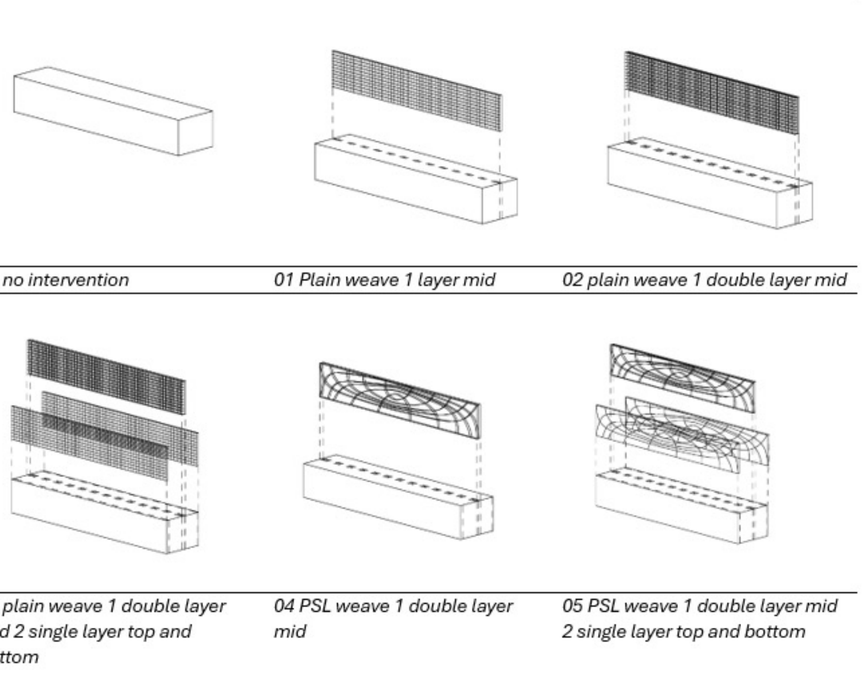
Mycelium- Based Composites (MBC) are a biologically grown material in which fungal mycelium binds lignocellulosic fibres into a lightweight structural composite. The practice of creating biomaterials such as MBCs employs a biodesign framework, integrating knowledge from engineering, art, science, and design.



- Material performance and structural limitations of MBC
- Insufficient computational integration for bio fabricated design
- Need for sustainable structural systems in architecture

Methodology

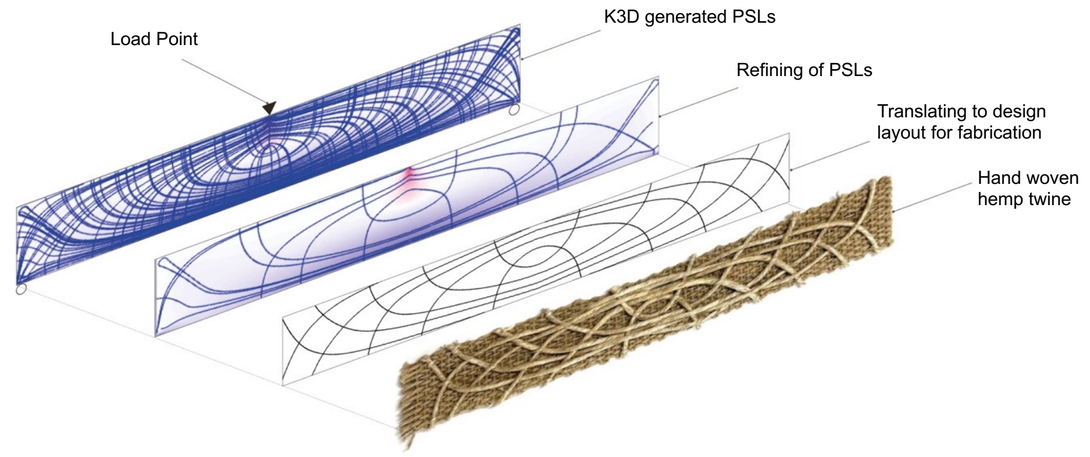
This research investigates textile reinforcement strategies to modify the structural behaviours of MBCs. Rectangular beam specimens were fabricated using a hemp shive substrate with varying hand-woven hemp textile reinforcement, inoculated with mycelium matrix (Ganoderma lucidum). Three-point bending tests were conducted using an ISO 178 guided methodology, adapted for thick, porous biological composites. Flexural stress, strain, modulus were extracted from stress-strain data to enable comparative analysis across reinforcement strategies.



00 no intervention	*01 Plain weave 1 layer mid*	*02 plain weave 1 double layer mid*
03 plain weave 1 double layer mid 2 single layer top and bottom	*04 PSL weave 1 double layer mid*	*05 PSL weave 1 double layer mid 2 single layer top and bottom*

Design and Fabrication

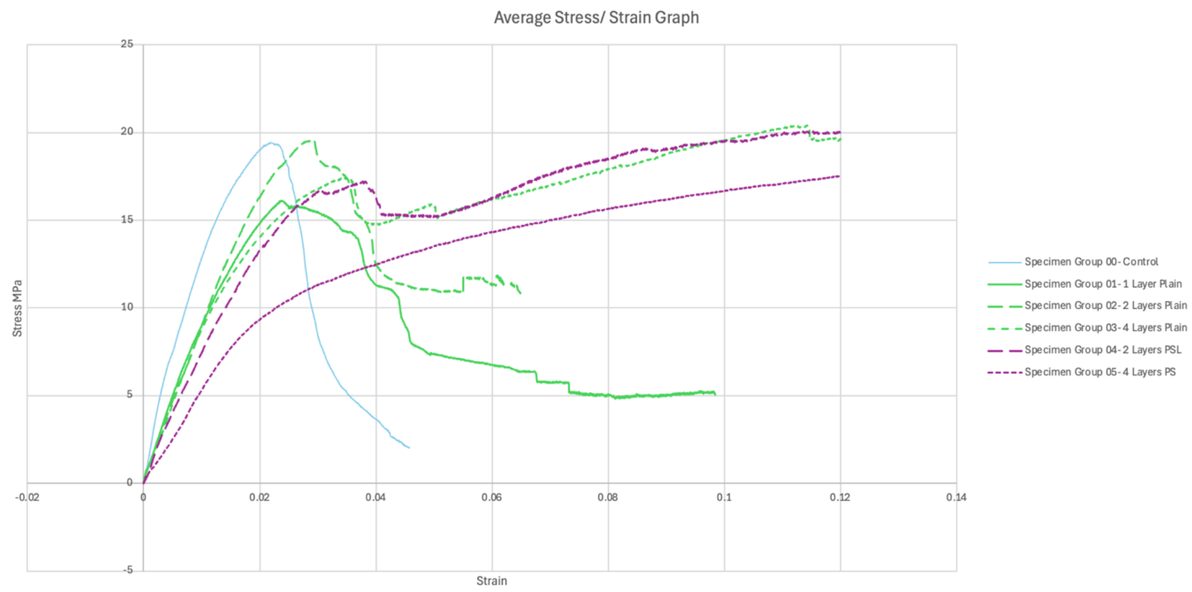
Geometries were defined in Karamba3D and Grasshopper softwares allowing for structural analysis of form, generating principal stress line (PSL) trajectories that were refined and extracted for fabrication.

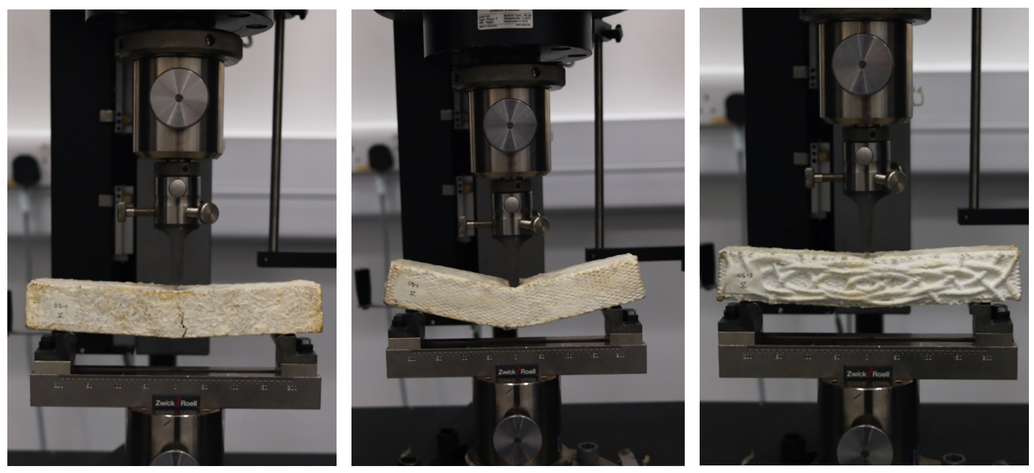


Specimens were placed in controlled environment allowing mycelium to fully colonise substrate over a period of 7 days before proceeding to drying out process which stops further mycelium growth (and mushroom fruiting!).

Testing and Results

Flexural testing revealed that textile reinforcement reduced initial elastic stiffness but increased deformation capacity. Reinforced specimens absorbed more energy than unreinforced controls and exhibited progressive failure rather than brittle collapse. These results demonstrate that reinforcement alters structural behaviour, rather than simply increasing strength.





Ongoing work investigates scaling strategies and architectural proof of concept elements focusing on human interaction. Further experiments explore compression behaviour, textile guided growth in complex geometries, and the use of mechanical data as design intelligence rather than material certification.

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Krebs Cycle of Creativity III, Neri Oxman, 2018
MBC image- Angelova, G.V. & Brazkova, Mariya & Krastanov, Albert. (2021). Renewable mycelium based composite – sustainable approach for lignocellulose waste recovery and alternative to synthetic materials – a review.
Engineered composite diagram, image- Dr. Scott Millen QUB lecture slide- AER4016: Mechanics of Aerospace Materials 4

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