Keywords
Mycelium composites,
Bioregional design,
Regenerative material and systems

Bioregional design and workflow of mycelium composite materials for the built environment

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The WHAT and THE WHY

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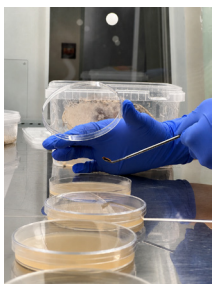
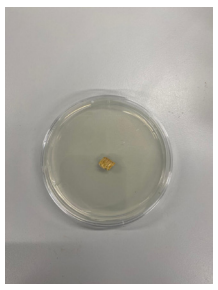
This research investigates the integration of bioregional design principles into the development of mycelium-based materials for the built environment. The study proposes an adaptable workflow for localised bio-fabrication based on locally available resources, ecological conditions, and territorial knowledge, developing an open and transferable protocol that can be reinterpreted actross different bioregional contexts. The research is explored through a case study in Valle d'Aosta (Italy), using forestry residues, dairy by-products, and endemic fungal strains for the development of mycelium composites. Through material mapping, substrate experimentation, and prototype development, the study examines the potential of bioregional approaches to support circular, decentralised, and regenerative material systems for the built environment

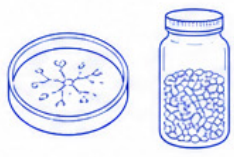
The HOW... workflow and protocol development

1. LOCAL RESOURCES

Mapping and selecting organic resources, waste, by-products available in a bioregion.

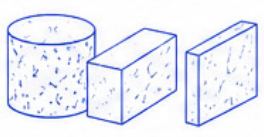
2. LOCAL FUNGAL STRAIN

Local fungal strains isolation and propagation on local grains to create grain spawn for inoculation on local substrate matrix.



3. BIOREGIONAL MYCELIUM COMPOSITES

Bioregional design, local materials, local production and supply chains.



1 RESOURCE MAPPING — Map and identify local organic resources, waste and by-products available.

2 FOREST SAMPLING — Collect samples from environments in the bioregion.

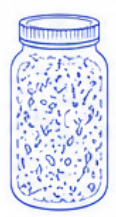
3 SPECIMENT COLLECTION — Collect fungal fruiting bodies or other specimens.

4 TISSUE ISOLATION — Isolate inner tissue under sterile conditions.

5 MYCELIAL CULTIVATION AND GROWTH — Culture isolated tissue on agar media until mycelial growth.

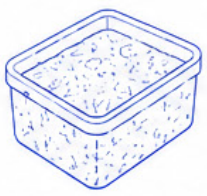
6 GRAIN SPAWN PREP — Prepare and sterilise grains for inoculation to produce spawn.

7 MYCELIAL COLONISATION IN INCUBATOR — Incubate grain spawn until fully colonised by mycelium.

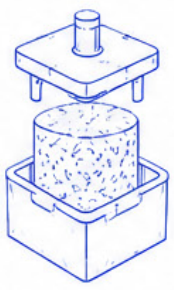


8 SUBSTRATE STERILISATION AND INOCULATION WITH GRAIN SPAWN — Sterilise local substrate materials and inoculate with grain spawn under sterile conditions.

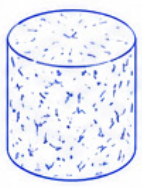
9 INCUBATION AND COLONISATION FIRST GROWTH — Incubate until the substrate is fully colonised and a consolidated biomass is formed.



10 MOULDING — Form and compact the colonised material into desired shapes.

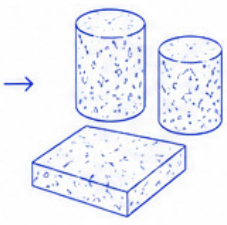


11 INCUBATION AND SECOND GROWTH — Incubate the moulded piece for further mycelial growth and binding.



12 DRYING AND PROCESSING — Dry the material to stop growth and improve mechanical performance.

13 FINISHED COMPOSITE MATERIAL — Obtain the final mycelium composite material ready for applications.



BIOREGIONAL INPUT

Use of local biomass, waste streams, by-products and endemic fungal strains.

BIOREGIONAL PRINCIPLES

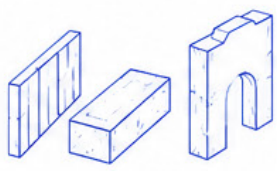
CIRCULAR
Valorising local resources and closing material loops.

REGENERATIVE
Support ecosystem health and biodiversity.

DECENTRALISED
Localised production and resilient systems.

APPLICATIONS

Thermal insulation, acoustic panels, interior finishes, and lightweight non-structural building components.



BIOREGIONAL DESIGN PRINCIPLES ACROSS THE WORKFLOW

LOCALLY ROOTED
Use local biological resources and knowledge.

CIRCULAR & REGENERATIVE
Return nutrients to the ecosystem and support local cycles.

ADAPTABLE & TRANSFERABLE
Workflow and recipes adaptable to other bioregions.

COMMUNITY & CONTEXT
Engage local stakeholders and respond to place-specific needs.

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