SP9: Material- and Structurally Informed Freeform Structures

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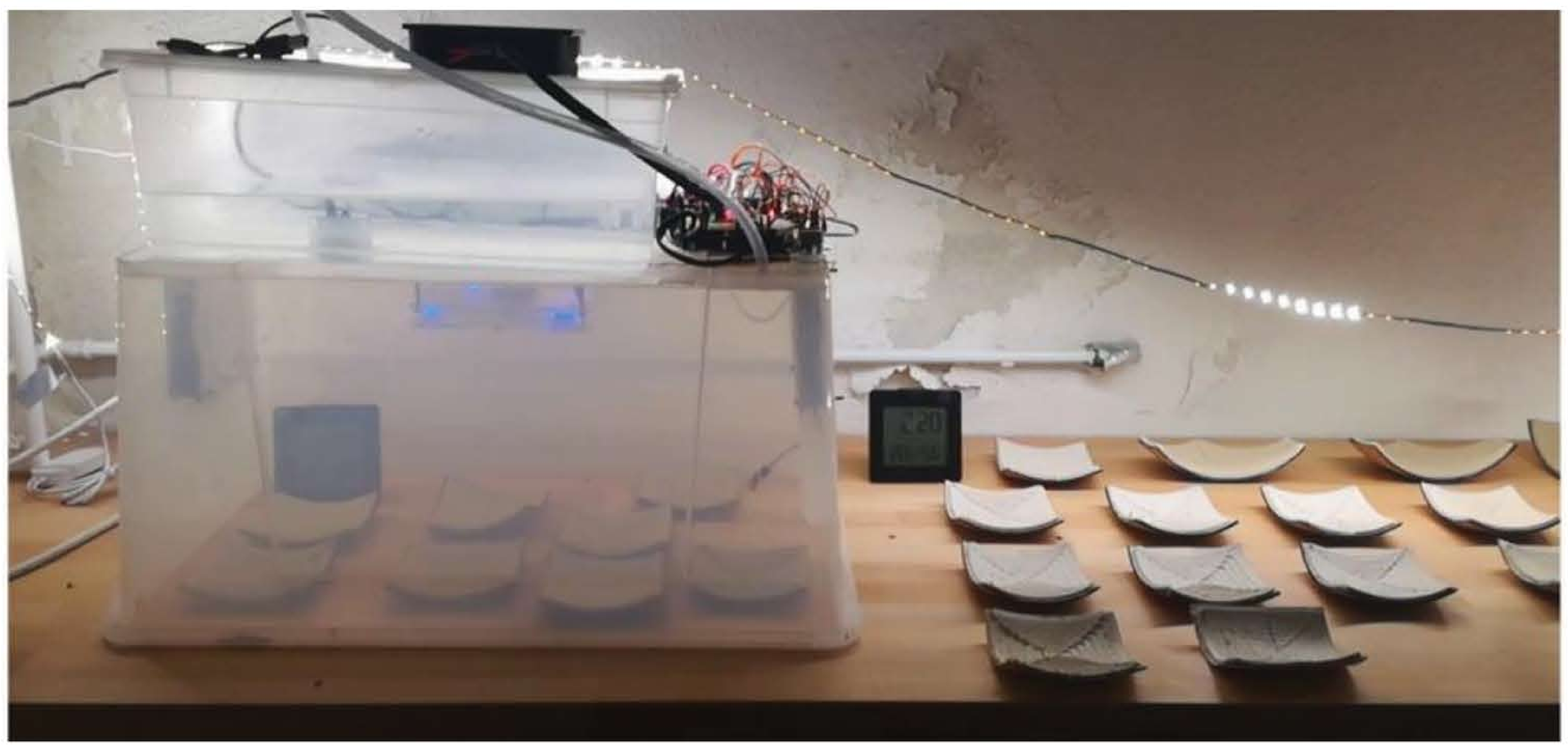
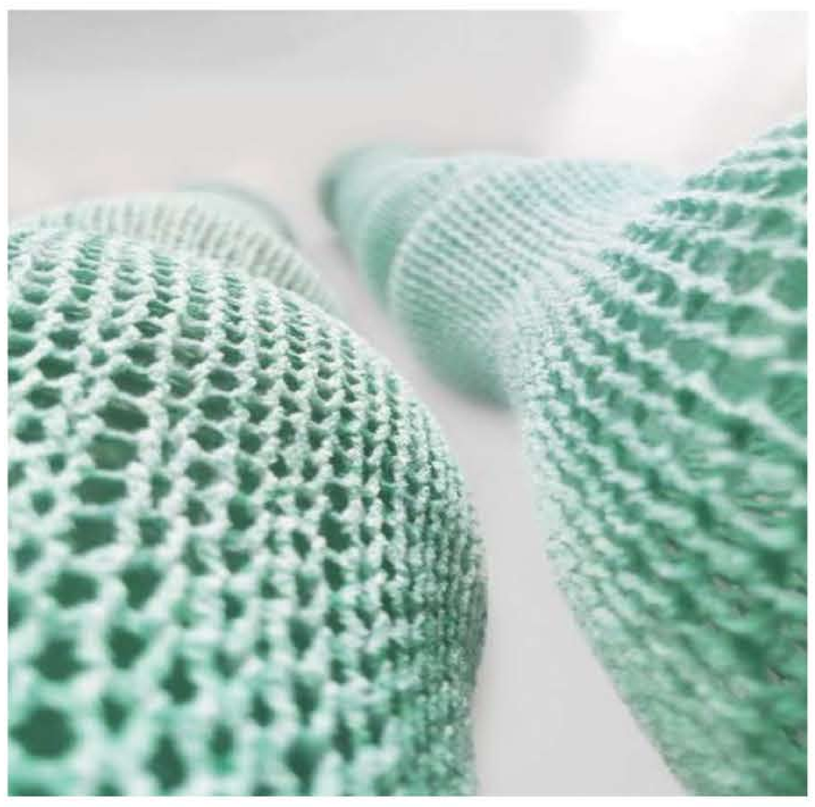
New controlled shaping method of thin-walled clay elements

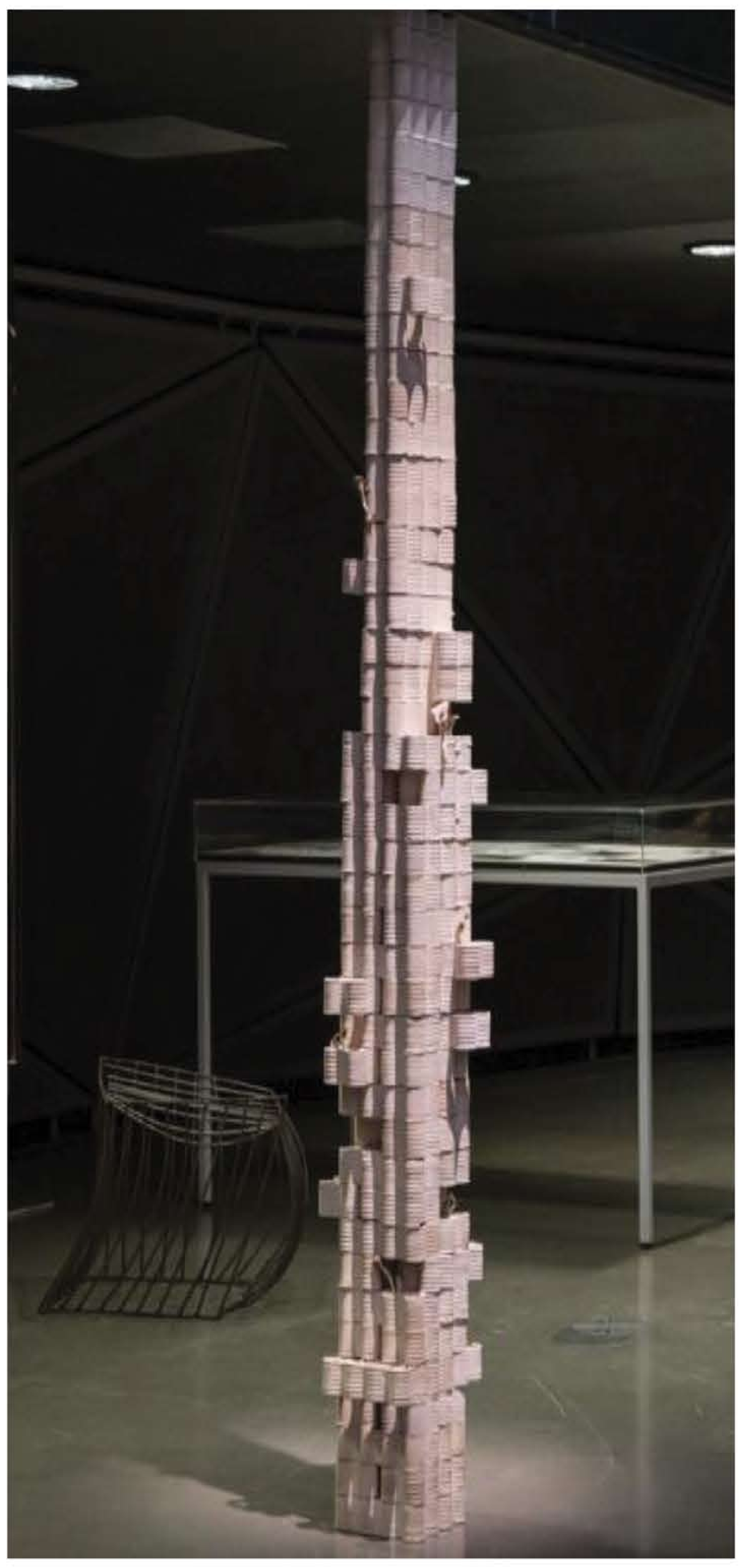
Our focus on shaping methods for planar elements led us to develop an alternative approach that eliminates the requirement for supporting structures such as knitted meshes. Collaborating with external experts in civil engineering and materials science we proposed a method for creating thin-walled clay elements. A clay layer is applied to a carrier material (CM), utilizing the shrinkage behaviour of clay as a shaping agent. This shaping process utilises the change of ratio of adhesion forces through the bond of a planar CM with a wet clay layer on its surface, and cohesion forces in clay, during the drying process.





Alginate

The increasing need for innovation in architecture has led to the exploration of alginate materials as a key focus in our research. We conducted a comprehensive series of experiments involving various natural additives to reinforce alginate as the matrix material. While taking cues from the natural tendencies of macroalgae, we also experimented with chitosan to enhance rigidity and glycerine to boost the elasticity of alginate. These experiments yielded a diverse array of structural elements, ranging from linear components to intricate membranes and resilient shells, demonstrating the versatile potential of alginate in architectural applications. This multifaceted approach to material development showcases the promising future of bio-based materials in the field of architecture.



Clay-mycelium composite “MyCera”

Experimenting with mouldable material – clay – we developed a new composite material, called *MyCera,* that consists of inorganic material – unfired clay – and organic material – mycelium (which is the vegetative part of fungi). *MyCera* has exhibited notable structural properties that open the possibility of implementing this composite in the building industry. Growing fibres through a mineral matrix of a composite is a very promising alternative to synthetic fibres for reinforcing Our scientific contribution is the successful development of a bio-processed material mixture that is suitable for digital fabrication, such as 3D printing, and facilitates the natural process of mycelial growth on low-cost raw materials.

Area 3: Form Finding

Filament-reinforced 3D printing of clay

In this collaborative research with SP3 and SP8, we developed a novel method for 3D printing of clay using controlled filament reinforcement. This involves customizing a paste-based 3D printer’s nozzle to accommodate filament co-extrusion for wet clay. Filament is positioned at the extruded profile’s center to enhance structural properties. Unlike conventional methods that randomly disperse fibrous materials into clay, this approach enhances bridging ability, increases tensile strength in dried elements, and offers non-catastrophic failure behavior. It extends applications to the construction industry, enabling versatile geometries and efficient lightweight element manufacturing.

Coextrusion of Clay-Based Composites

A collaborative project with SP8 presents a method utilizing coextrusion of clay and clay-based composites, allowing varied material distribution in a single printed element. Achieving this requires novel nozzle designs, additional machine components, software, and material property research. Coextrusion was used to create ceramics with gradient material properties through variable additive introduction. Gradient porosity in 3D printed clay results in diverse material properties within a single object, applicable in building industry for structural, insulation, water absorption, and acoustic variations.