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3D-Printed Earthen Architecture: From Material Research to a 1:1 Sustainable Prototype at the IAAC Forest Campus

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ABSTRACT

This research investigates how material and construction research can advance 3D-printed earth from experimental fabrication towards a technically resolved and inhabitable architectural system. Additive manufacturing is offering new possibilities for automation, material efficiency, reduced waste, and architectural freedom.
Developed within the Postgraduate in 3D Printing Architecture at the Institute for Advanced Architecture of Catalonia (IAAC), the project builds on ten years of research at the IAAC Forest Campus. The 1:1 construction process functioned as both a testing ground and a method of knowledge production. The prototype demonstrates that earthen 3D printing is not simply an automated process, but an iterative relationship between material, machine, architect, architectural design, and construction. Matter research focused on grain-size distribution, additive formulations, and surface coatings, while construction research investigated wet-state wall stability, ventilation for drying, window and door installation cavities and joinery details, timber-to-earth connections, and performative wall textures.
As a result, the completed prototype brings together spatial design, fabrication constraints, and performance-driven strategies within a single built artefact. Adaptable connection details further demonstrate how 3D-printed earthen walls can be integrated with timber elements, existing prototypes, and potential future extensions, contributing to the development of flexible and sustainable construction systems.

Keywords: *Hands-on research; 3D-printed earthen architecture; Mixture optimization; Additive manufacturing; Robotic fabrication.*