SVEN PFEIFFER

MATERIAL vs MACHINE TRAJECTORIES

Format: exhibition of models/prototypes, lecture

MATERIAL vs MACHINE TRAJECTORIES examines the potential to imagine design and building in a more sustainable cycle, no longer ranging from raw material to waste material, but instead from matter to materials and back. The rapid expansion of urban areas is accompanied by a great amount of building activity and materials to be brought to cities and to be relocated within the city area. This activity is increasingly problematic, due to large amounts of grey energy used and other negative environmental impacts. The project's aim is to develop techniques for building with local earthen materials such as clay and innovative fabrication processes. The abundance of clay in the Berlin area and its specific material properties make it very relevant for sustainable and local production, however the handling of earthen materials is known to be a time-consuming and above all manual process. With advanced fabrication methods such as additive manufacturing, the deposition of the material can be automated and complex structures are made possible. In the project a flexible experimental design and fabrication environment for working with the properties and capacities of clay is created. Whereas the common materials in 3d printing such as PLA or ABS are stable during the printing process, earthen materials will behave differently depending on the proportion of material to water, the geometry, the printing speed and the discharge volume. Therefore, the production data set has to be adjusted accordingly and the properties of the material have to be continuously negotiated with the degrees of freedom of the robotic printing process. In several workshops with collaborating partners, various tool-based conditions and parameters (extrusion direction, extrusion speed, extrusion thickness) and the resulting material behavior are evaluated to provide useful feedback for further iterations. Coincidences, repairs and defects are explicitly part of the process. By exploring the real-time interaction between code, matter and machine parameters, a direct feedback between making and thinking becomes an integral part of the design process. Throughout the process, the recombination of algorithms led to material depositions which are not possible to achieve with traditional production methods. The resultant objects can be considered "pre-architectural", testing the constructive limits of the process and negotiating information, form and structural properties. The project conducted in collaboration with researchers and students form the TU Braunschweig and UdK Berlin will continue examining other fabrication processes and material systems with a focus on the geologic and geographic conditions of the greater Berlin area. Further tests will focus on scalability of the production process and on the integration of structural and material properties with various architectural parameters, which are essential for the generation of different spatial qualities.

Keywords: man-machine-interaction, additive fabrication, local construction

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Material Machine Trajectories

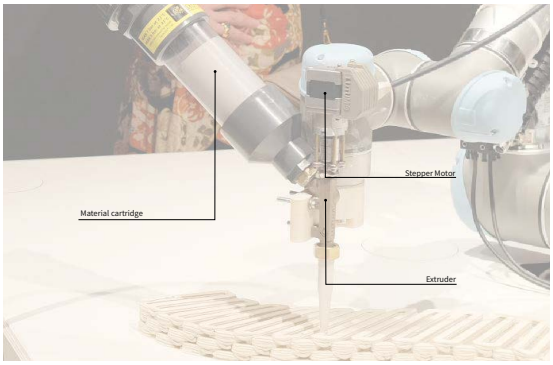
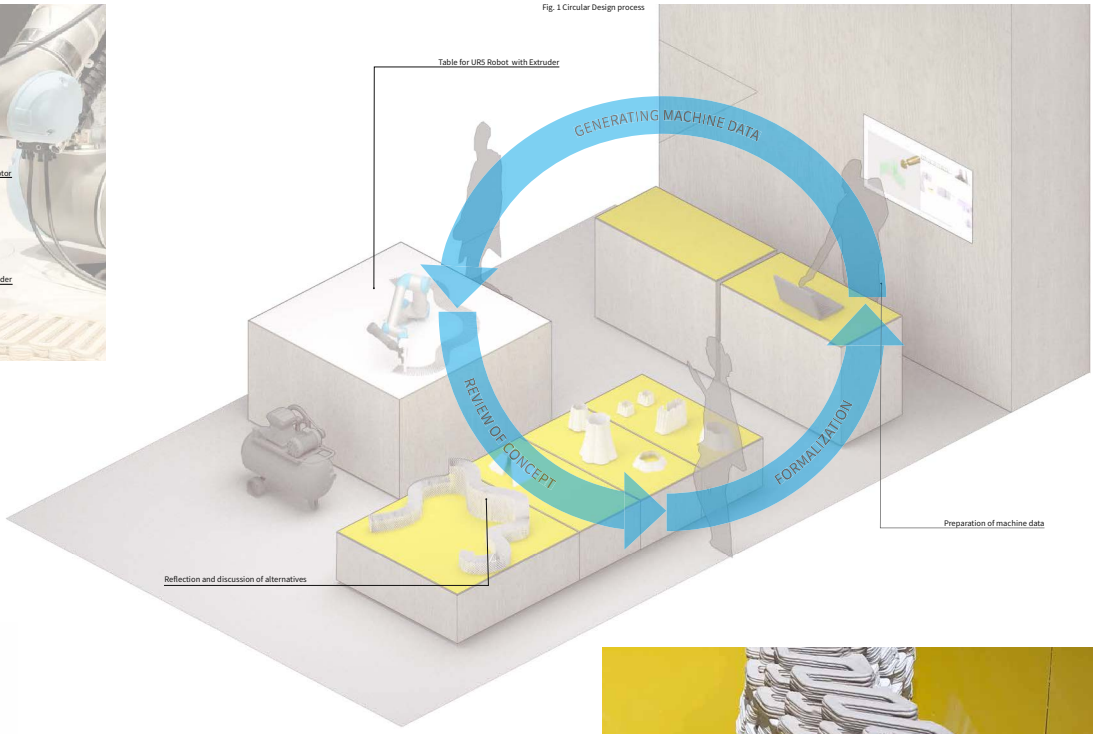


Fig 2. Extrusion Setup for ceramic materials

Fig. 1 Circular Design process



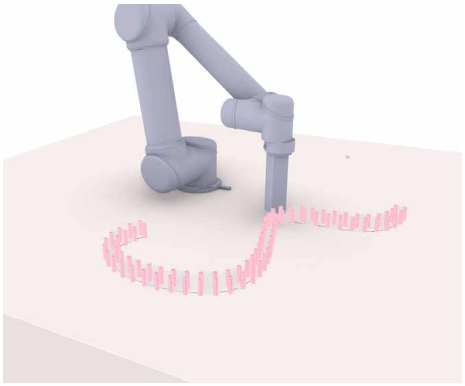


Fig. 7 Robot simulation i

Fig. 6 Different nozzle sizes

Fig 10. Shifted layer setup with varying thicknesses

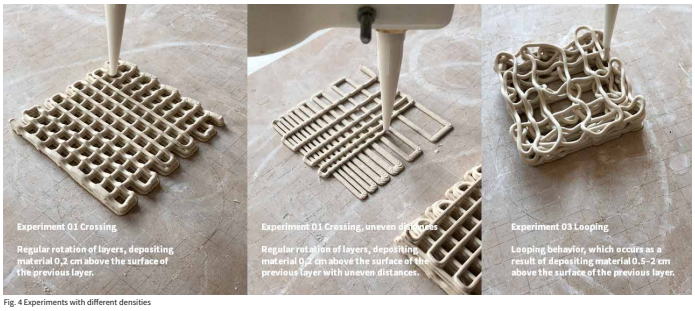


Fig. 4 Experiments with different densities

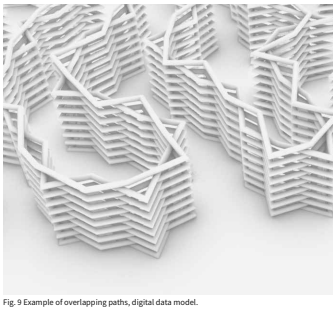


Fig. 9 Example of overlapping paths, digital data model.

Fig. 11 Locally available earthen Materials, Ziegelmanufaktur Glindow

Fig. 12 Pre-Processed Clay, Ziegelmanufaktur Glindow

Specifications of the Experimental Setup:

Robot: 6-axis Robot Arm Universal Robot 5
Weight: 18,4 kg, Payload: 5 kg, Reach: 850 mm
Freedom of movement: +/- 360° an allen Gelenken
Speed: Joint: Max 180°/Sek.
Exactitude: +/- 0,1 mm
Extruder: https://lutum.vormvrij.nl/

Research Partners:

IMD _Institute of Media and Design, TU Braunschweig
WM Caroline Høgsbro, WM Lara Wischnewski
Team: Iman Zangooeinia, Ava Sadeghipour, Daniela Krause, Esra Oruc, Rolf Starke, Luisa Buchholz
David Weigend, Futurium
David Karl, Keramische Werkstoffe, TU Berlin

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