The relationship between maker, machine and material: Creative investigation of geopolymer extrusion 3D printing

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Geopolymer Camp

Radical Ceramics

- **Empirica** is an interdisciplinary research group where practices of art, design, and craft are used as vehicles of inquiry.
- Radical Ceramics is a new initiative at Aalto University between two schools: **the School of Arts, Design and Architecture and the School of Engineering**.
- In the **Radical Ceramics** project we explore clay as a material for geopolymers and the possibility of using geopolymers in the context of studio ceramics.
- https://empirica.aalto.fi/radical-ceramics

Project Team

ARTS-team:
Maarit Mäkelä, PI, Associate Professor. Doctor of Arts and Artist working in the field of contemporary ceramics.

Priska Falin, postdoctoral researcher conducting practice-led research on ceramics and its processes.

Riikka Latva-Somppi, doctoral candidate conducting practice-led research on ceramics and its processes.

Tomi Pelkonen, Studio Master, Ceramics.

Johannes Kaarakainen, Contemporary Design MA student, research assistant.

ENG-team:
Jussi Leveinen, Co-PI, Professor of Mineral Based Materials and Mechanics.

Luis Huaman, Doctoral candidate, working on geometallurgical characterization of battery mineral ores for beneficiation optimization processes. Co-innovator of a patent WO2019190334A1.

Ville Repo, Doctoral candidate, application of rock aggregate wastes in concrete production.

Lennart Engels, Contemporary Design MA student, research assistant.

About me

- Master of Arts student in the Contemporary Design Program at Aalto University
- Workshop assistant in the 3D print workshop of Aalto University
- Research Assistant in the Radical Ceramics project of the Empirica research group at Aalto University

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Arch Tray, 2023

Devil’s Tray, 2023

Creative investigation of geopolymer extrusion 3D printing

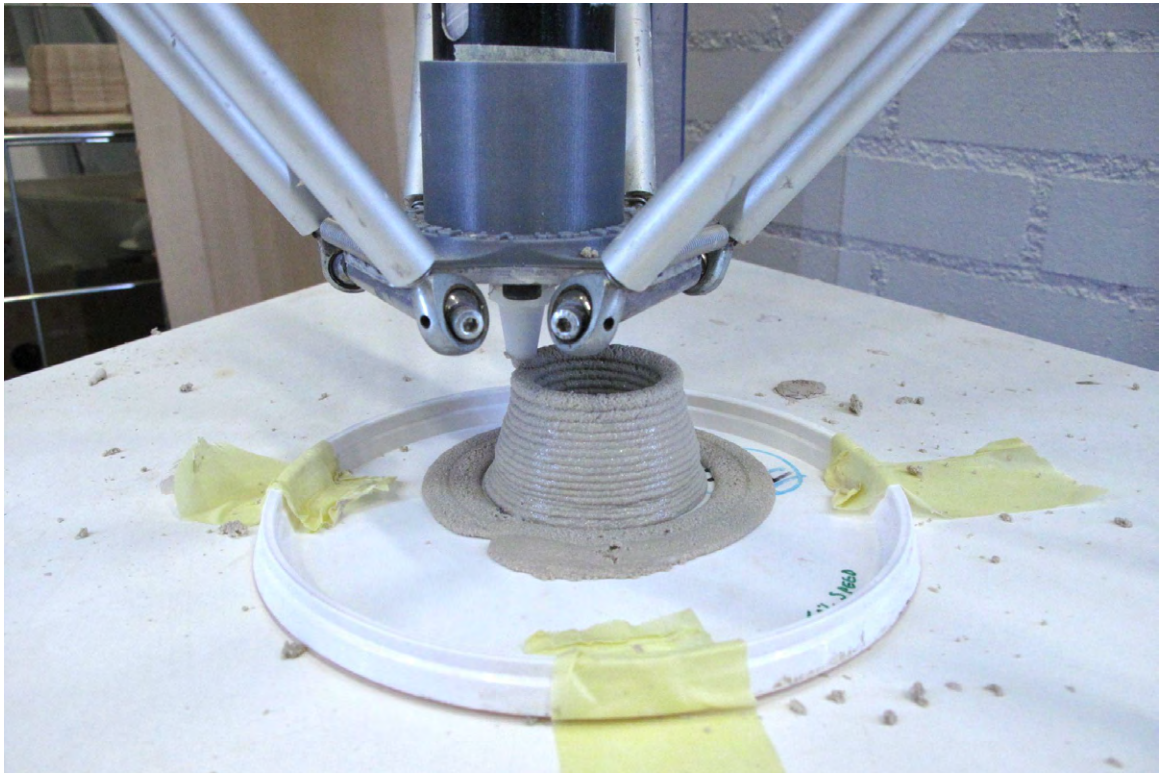
- Geopolymer extrusion printing is researched from the perspective of digital craftsmanship through an analytical investigation of the entanglement of the maker, machine and the material.
- Explore the possibilities of using geopolymer extrusion 3D printing on a local, small scale in a creative studio context.

Experimental geopolymer extrusion printing methods

- Materials used: MK-based Na-Sil geopolymer pastes with chamotte and feldspar as filler materials.
- All samples have been cured at 80°C for 24 hours.

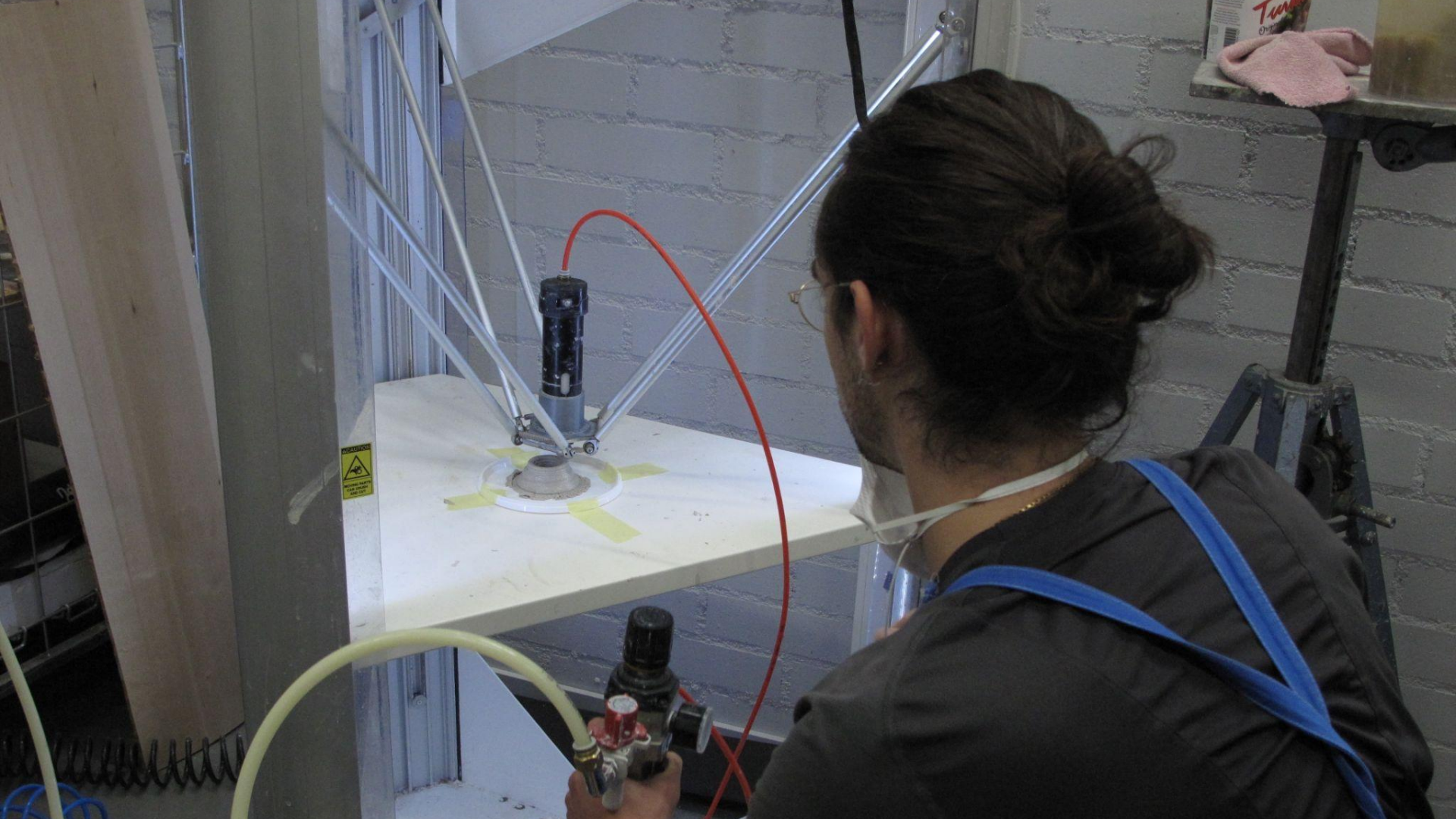
Hand printing

- Physical and intimate relationship between maker, machine and material.
- Organic and intuitive visual language



Pressure-driven extrusion printing

- We adapted a pressure-driven extruder to the Delta Wasp 40100 clay printing machine.
- Explore different print settings in slicing software.
- machine and material act in a symbiotic manner to produce the desired object
- the maker takes on the role of observer during the making process

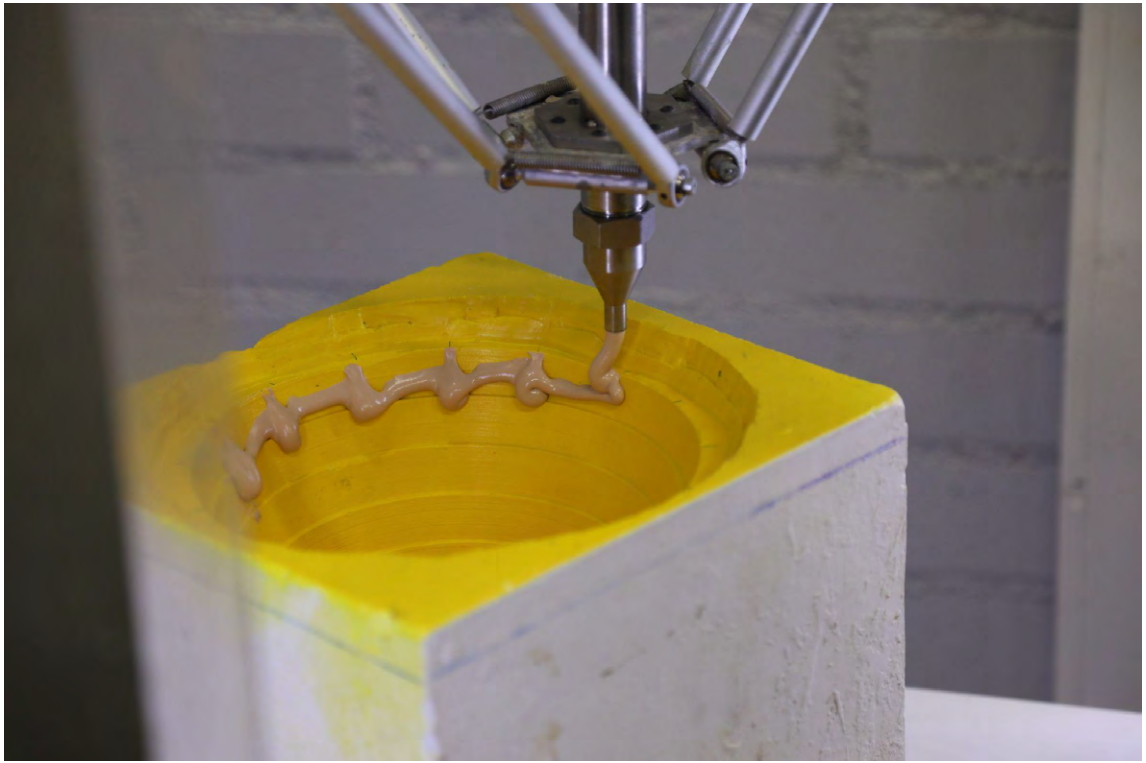


WASP - Manual Feeding Extruder

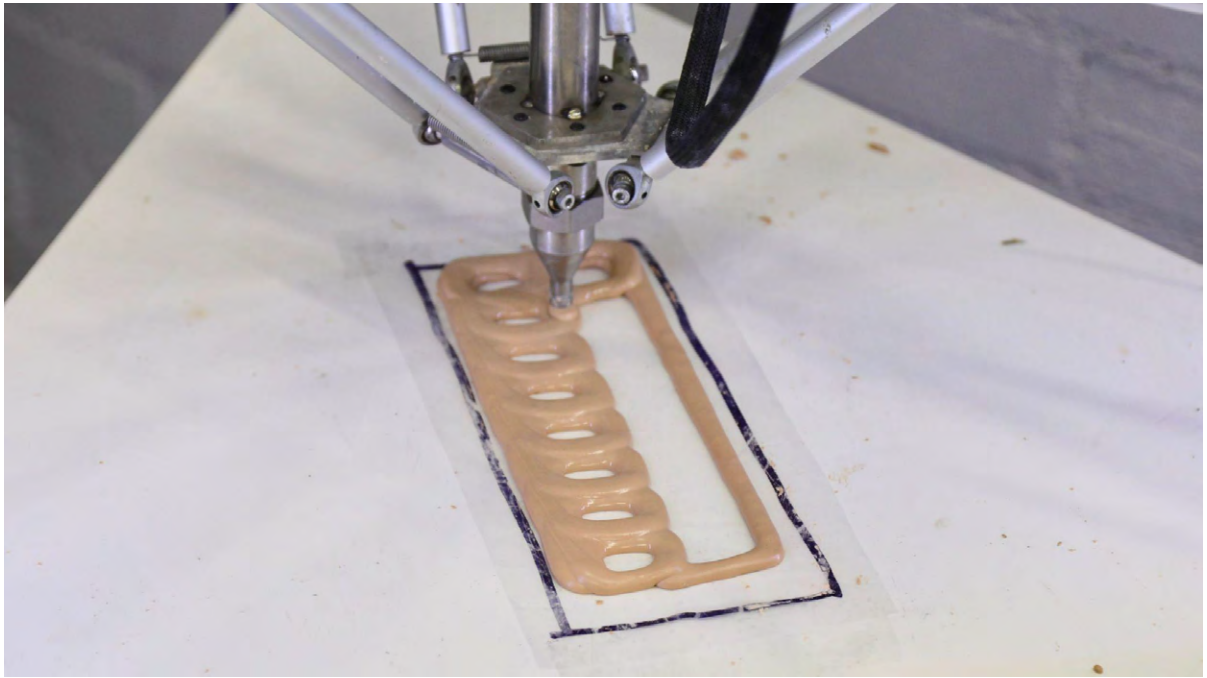
Printing on a mold or concave surface

- Concave surface acts as the “structural layer” of the object.
- A synergetic relationship is formed between maker and machine, allowing for unconventional results that may arise from the process of designing and making.

Drip printing



- No CAD model is involved in the design process
- The maker communicates directly with the machine through custom written G-code.
- In the process of making, the maker acts intuitively by spinning the mold to create a unique ,web-shaped object.



Extrusion printing on a flexible material

- The object is printed on a flexible surface. Afterwards, it is placed on a mold to give it shape and structure.
- In the act of producing the flat object, the maker observes. In the second phase of production, the maker is active and manipulates the object.

Conclusion

Within contemporary practices, where the machine or the creative tool has an elemental part of the creative process, there is a part of the process where the machine is producing, and the maker is observing the unfolding of an object. This phase is drawing the maker, material and machine together and allowing the maker to learn, re-evaluate and ideate during the making. In this context, the relationship between the maker with the material and the machine becomes critical. The machine and the material have their limitations as well as possibilities, and these have to be understood and solved by the maker.

Thank you for your attention