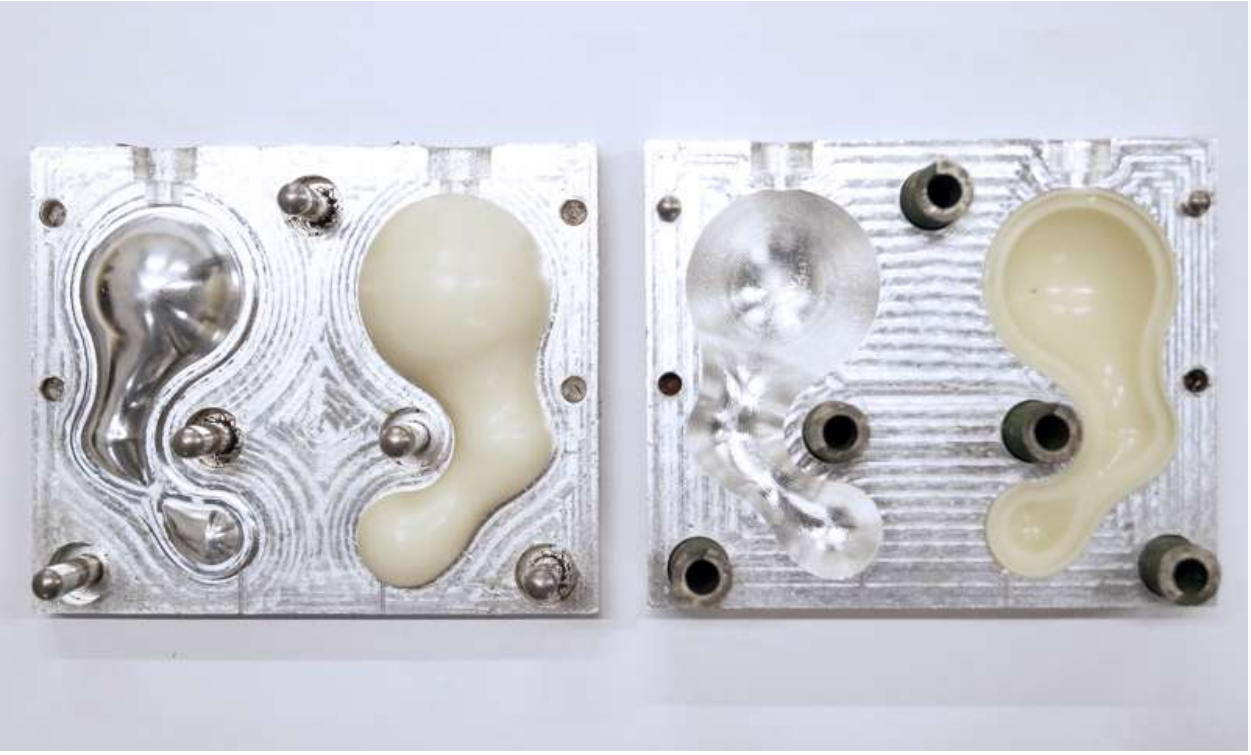
MArch Architecture Design: Research Cluster 4
2016–2017 Manuel Jimenez, Vincente Soler, Gilles Retsin



Large-Scale Discrete Fabrication: Particles, Parts and Meta-Parts

We have never been Digital

Architecture has never been digital: despite the use of computers to calculate huge amounts of complexity, the way we build is still analogue, and therefore our increasing computational power is merely used in a representational way. The term 'digital fabrication' is misleading as well; 3d printing is an analog process, similar to the way the CNC mill automates an artisanal action. Research Cluster 4 is interested in an architecture which is fundamentally digital, both as a design process and as a physical artefact. Thinking about architecture in a digital way means that we have to think about every element, part or particle as a bit of data that can be computed. Parts therefore take on the properties of a 'bit', becoming serialised, standardised and embedded with a simple rule: 0 or 1 (or, connected or not connected). RC4 develops design processes and discrete fabrication techniques to automate the assembly and computation of these elements. The emphasis on the part as a unit reintroduces the age-old disciplinary notion of part-to-whole relationships. This, we argue, has major implications for how we think about design, composition, authorship and process. It also enables the full automation of building, new modes of interaction with users and public, and fundamental changes to how architecture is traditionally produced and procured.

Double Discrete

RC4 is interested in architecture that is both digital by design and digital as a physical object. Although computer controlled, most current fabrication technologies are actually analogue processes. These computer controlled actions are essentially mechanised artisanal procedures - which replicate human modes of production. These techniques can be understood as analogue, as they are based on procedures that continuously add or remove material. Of course the tools are computer controlled, but they are not "digital". The project for a “double discrete” - digital by design and physical organisation - is not only a critical, architectural proposition. There are also a series of more pragmatic, logistical concerns. Continuous systems have fundamental problems with transitions of material, require a lot of time to compute and fabricate, are less adaptive and not reversible. Concepts such as “digital materials”, developed at MIT by the Centre for Bits and Atoms help us understand the implications of the digital organisation of physical matter. (Gerschenfeld, 2015)

Particles, Parts, Meta-Parts

This year RC4’s main aim is twofold: to scale up discrete fabrication processes to 1:1 building-scale prototypes and to develop complete architectural proposals. Scaling up discrete assembly processes with an order of magnitude requires highly engineered parts, with a specific materiel organisation and structural behaviour. This necessity gives rise to the concept of the meta-part: a large-scale, discrete element that in itself is composed out of many smaller, serialised parts or particles. Students will explore different fabrication techniques such as robotic wire-bending, spatial 3D printing, casting or assembly to build particles with digital properties, which can then be assembled into parts and subsequently meta-parts. This nested procedure is always based on digital connection schemes and discreteness: the particle can never be a derivation of the part and vice-versa.

1:1 Architecture, Learning the whole.

Experimentation with complete architectural proposals becomes a platform to discuss and develop ideas about production, spatial consequences, structure and composition. Students will be asked to develop complete building proposals, starting initially with a simple two-floor slab structure, but ending with a larger and more complex, multi-layered building system. This building system will be non-typological: it is a mere set of part-to-whole relations, which can be deployed into different buildings. Prototyping a building proposal will allow the engagement with the system beyond just engineering logistics. These building models will be tested as 1:5 or 1:10 robotic assemblies. Making use of the reciprocal scheme behind the projects, these models are both traditional scale models or representations of a larger building, as well as robotic assembly prototypes. The emphasis on the building as an open composition, or non-holistic set (Sanchez, 2014), necessitates computational methods which can develop meaningful and efficient organisations of parts. RC4 will specifically focus on developing computational mechanisms and procedures which can help us generate relations between whole and part-part combinations. Computational techniques such as machine learning will be tested to inform decision making in combinatorial systems. Other procedures will be focused on physical digitality in the context of fabrication: tracking and cognition of elements in physical space, with direct feedback to their assembly.

Postscript: Digital after Digital

The domain of contemporary architecture has been reduced to cosmetic surface operations, confined to the centimetres-thin surface of the facade of the suspended ceiling. The so called post-digital indirectly accepts this reduction of the profession, by developing actions and theories that only operate on the qualities of the object - its material, texture or figure - communicated to us through surface. But what if we do not surrender to the surface? This new kind of architecture, emerging from digital part-to-whole relations and discrete fabrication, has radical implications. There is no more surface, no topology, no classical geometry defined by vectors, lines or meshes. There are no more types like beams, columns or bricks either: just the digital organisation of serialised parts. Students will explore the consequences of this fundamental discreteness: its efficiencies, logistics, performance but also its aesthetic implications and architectural meaning.

Gerschenfeld, N, Carney, M, Bennett, B, Calisch, S and Wilson, S 2015, 'Macrofabrication with Digital Materials', Architectural Design, 85(5), pp. 122-127
Sanchez J 2014 Polyomino – Reconsidering Serial Repetition in Combinatorics, ACADIA 2014