

## Aarhus School of Architecture // Design School Kolding // Royal Danish Academy

### Persistent Model #3

Ayres, Phil

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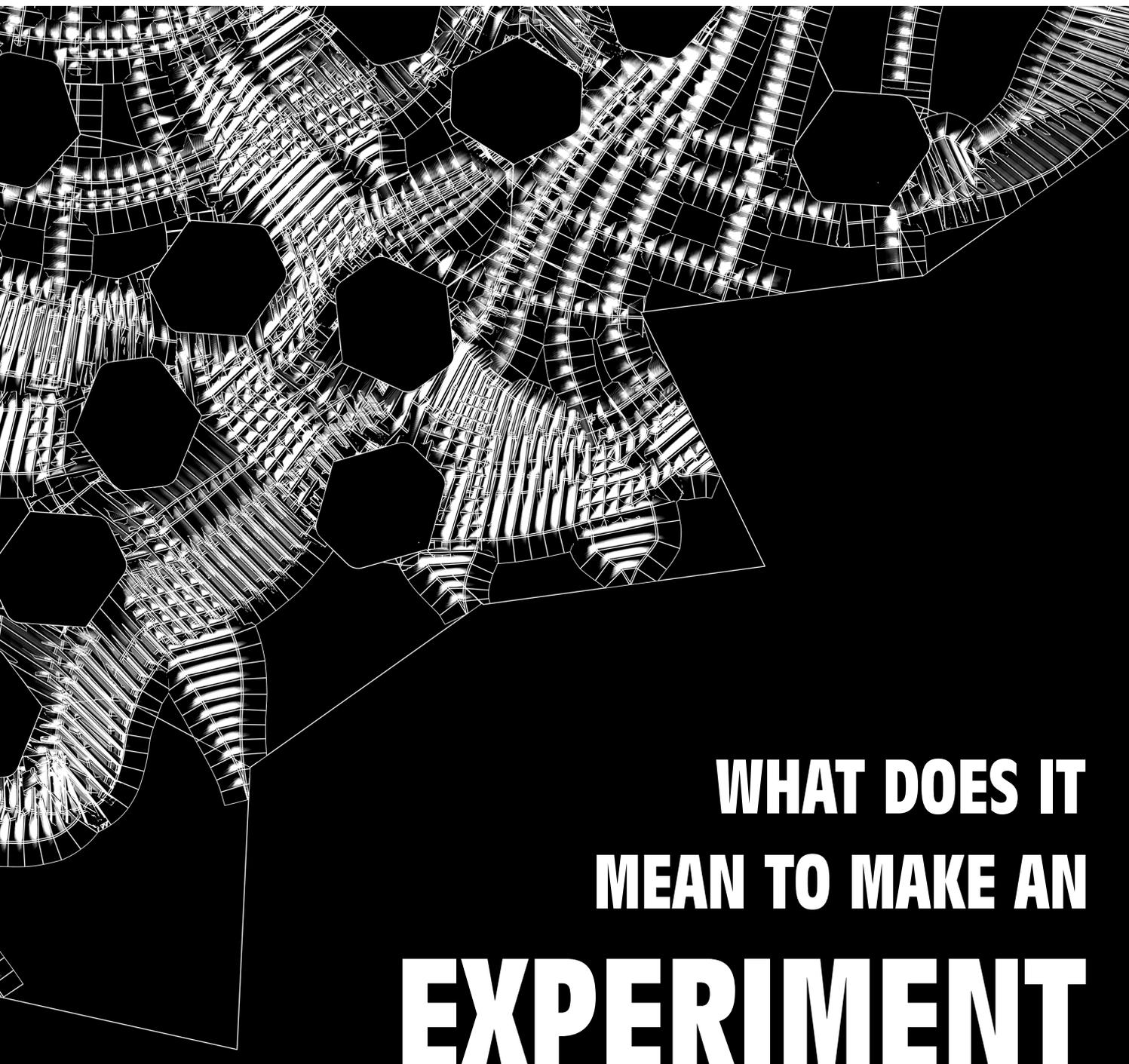
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**WHAT DOES IT  
MEAN TO MAKE AN  
EXPERIMENT**

**EXHIBITION**  
THE ROYAL DANISH ACADEMY OF FINE ARTS  
SCHOOL OF ARCHITECTURE AND SCHOOL OF DESIGN

22 MARCH - 14 MAY · OPEN ALL DAYS 11 AM - 6 PM · FREE ADMITTANCE  
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# PARTICIPANTS

With a strong focus on computation, material and form, the project takes place between research environments at the Royal Academy of Fine Arts School of Architecture and School of Design:

## CITA

Center for Information Technology and Architecture; Architecture School

## SuperFormLab

Design School

## Department of Textiles

Design School

The project and its experiments are managed by:

### Martin Tamke

Architect and Associate Professor at CITA, School of Architecture

### Troels Degn Johansson

Associate Professor and Head of Research at the School of Design

The project is supervised by an international panel of experts:

### Malcolm McCullough

Theoretician, Author and Professor at University of Michigan, Taubman College of Architecture and Urban Planning, USA

### Carol Collet

Textile Designer and Director of MA Textile Futures Course, Central Saint Martins College of Art and Design, London, UK

### Mette Ramsgard Thomsen

Architect and Professor and Head of CITA

### Thomas Binder

Associate Professor at the Danish Centre for Design Research

The research team consists of:

### Paul Nicholas

Flemming Tvede Hansen

Malene Kristiansen

Mary Ann Hansen

Phil Ayres

Martin Tamke

Jacob Riiber

Henrik Leander Evers

Claus Rytter Bruun de Neergaard

David Stasiuk

Mette Ramsgaard Thomsen

The setup of the exhibition was supported by students from the Design school under the guidance of

### Hollie Gibbons:

Claudia Tannenläufer

Vanessa Dietrich

Wing Chun Noah Cheng

Lærke Isbrandt Bach Jansen

Simon Bøcker Mørch

Adrienne Lee

# SYMPOSIUM

Friday 25.th of April 2014,  
10.00-17.00h

Venue: Auditorium 2, Holmen,  
Danneskiold-Samsøes Allé 51,  
Copenhagen

The international symposium continuous and expands the discourse of the exhibition. Entry to this event is free for public and academia. With our guests:

### Daniel Charny

Designer, curator of the "In the Making" exhibition V&A

### Burkhard Schmitz

Designer, 75 Studio, Berlin

### Carol Collet

Textile designer, Central Saint Martin London, member of the project's advisory panel

### Marjan Colletti

Architect, The Bartlett, Uni Innsbruck

### Jenny Sabin

Architectural researcher, US

### Paul Nicholas

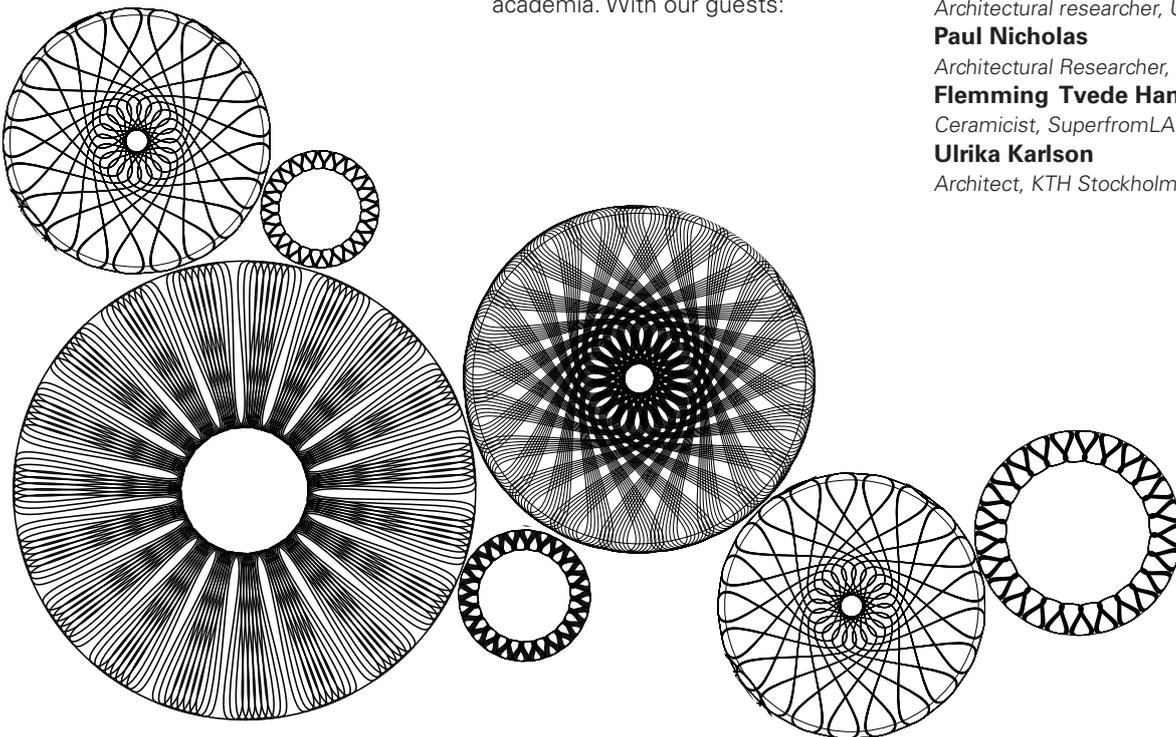
Architectural Researcher, CITA

### Flemming Tvede Hansen

Ceramicist, SuperfromLAB

### Ulrika Karlson

Architect, KTH Stockholm



# INTRODUCTION

“What does it mean to make an experiment” investigates the position, role and significance of the experiment within practice-based research. In architecture and design, the experiment is a particular mode of exploring the multiple and heterogeneous intersections that emerge from social, conceptual, technological, material and cultural contexts in which it is sited (Hagner, Rheinberger 1994)<sup>[1]</sup>. The exhibition showcases interdisciplinary experiments that act as research probes.

They each hold their particular digital-material relation, and yet all contribute to exploring the ways in which technologies are radically expanding our material processes and techniques. The exhibition aims to discuss how experimental practices generate a particular set of knowledge types, and how this informs design thinking through drawing, modeling, prototyping and building. In this sense the experiment is a site of making and reflection, as well as of synthesis and innovation.

## EXPERIMENTS AS CHALLENGE IN ARCHITECTURE AND DESIGN

Experimental procedure employ a broad range of investigations. From theoretical studies, digital technologies and analogue material experiments to interdisciplinary methods of transferring technological and conceptual practices from related research fields. Where an experimental practice is often only observed in a natural-science context “What does it mean to do an experiment” asks what happens when practice-related methods (practice-based research) and design-based research (research by design) are deliberately infused with scientific methods of experimentation.

Throughout the project we understood the breadth and meaning of experimental practice through four perspectives:

### Experiment as place of reflection

Design as a method of inquiry is a reflective practice in which the designed engages in a dual mode of reflecting on action and through action (Schön 1993)<sup>[2]</sup>. Moving between the exterior and the interior of making, design creates a conversation between the dissective action of analysis and critical assessment and the creative action of proposition and result. Design inquiries are thus, potentially at the same time, a material practice and a contribution to the production of knowledge (Brandt & Binder, 2007, Koskinen et. al., 2008)<sup>[3]</sup>.

### Experiment for creating evidence of thesis

We inherit a long history of experimental practice, formed around ideas of versioning and iteration. This legacy is an inherently physical thinking of the successive move through the scales of the 1:1 experiments by François Hennebique, Robert Maillard or Eladio Dieste. These physical experiments act as material research inquiries by which the concepts and technologies of the research are tested and evaluated. The emphasis on the implementation allows design projects to engage directly with the investigated techniques and technologies moving along from design and analysis to specification and fabrication. Physical experimentation is therefore a key to understanding and dissecting the complex hybridity and inherent interdisciplinary nature of the research field.

### Experiment as speculation

Design is a powerful form of experimentation: a means for inquiring and of producing knowing (Binder & Redström, 2006)<sup>[4]</sup>. “It is concerned with moving away from the existing and the known, through intentional actions to arrive at an as yet unknown, but desired, outcome” (Downton 2003)<sup>[5]</sup>. Design is therefore an active process by which the designer poses a question and develops its dimensionality and solution, and in which the identified design criteria are evaluated in context of a given problem (Buchanan 1992)<sup>[6]</sup>.

### Experiment as interface

As a tool for supporting synergy, the experiment, as well as its outcomes, acts as a boundary object (Star & Griesemer 1989)<sup>[7]</sup>, and an interface that provides a common ground for interdisciplinary collaboration. When disciplines collaborate to create new knowledge, meanings and approaches are not necessarily shared across borders. They need to be reconciled, as objects and methods mean different things to different people. The experiment resides at the interface, enabling a continual exchange of concepts, tools and technologies.

[1] Hagner, Michael, Hans-Joerg Rheinberger and Bettina Währg-Schmidt (eds.) (1994), *Objekte, Differenzen und Konjunkturen, Experimentalsysteme im historischen Kontext*, Berlin: Akademie Verlag.

[2] Schön, Donald (1993) *The Reflective Practitioner. How professionals think in action*, Temple Smith, London.

[3] Koskinen, I., Binder, T. and Redström, J. (2008), *Lab, Field, Gallery and Beyond*, Artifact, Vol 2 Issue 1 Routledge.

[4] Binder, T. and Redström, J. (2006) *Programs, Experiments and Exemplary Design Research*, full paper, Wonderground conference, Lisbon.

[5] Downton, P. (2003). *Design Research*, RMIT Press

[6] Buchanan, Richard (1992) *Wicked Problems in Design Thinking in Design Issues*, Vol. 8, No. 2 (Spring, 1992), pp. 5-21, The MIT Press

[7] Star, Susan; Griesemer, James (1989). “Institutional Ecology, ‘Translations’ and Boundary Objects: Amateurs and Professionals in Berkeley’s Museum of Vertebrate Zoology, 1907-39.” *Social Studies of Science* 19 (3): 387–420.

# EXPERIMENTS

Experiments are at the core of the two-year project. The experiments are conducted by researchers with backgrounds in the partaking schools and an existing strong focus on materials or computation. The research questions for the experiments were established in the participants work and allow for targeted experimentation. The experiments are interdisciplinary in nature. They exist around a collaboration of the researcher with existing faculty and facilities of both

the School of Architecture and Design. Where each experiment has found their cross-disciplinary partner from their local environment, all of them are situated in a network of partners from an academic and industrial background. This allows the experiments to tackle scale and engage with real-world production techniques and materials. The network challenges the experiments as well, with questions of applicability and provides impulses for further speculation and development.

## MATERIAL AS SITE OF EXPERIMENTATION



The physical presence of materials constitutes both design and architecture. Here, material is the interface between the conceptual and speculative and the perception and reflection by the public and diverse professions. Architecture and design share a material practice that is informed by a tactile understanding of its processes and is deeply rooted in the crafts (Picon 2010) [8]. Both have developed their experimental practice, where the drawing, the model and the 1:1 have their role and meaning.

### A new material nearness

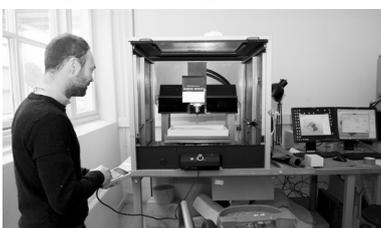
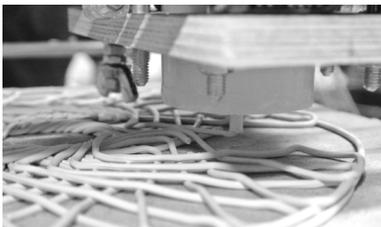
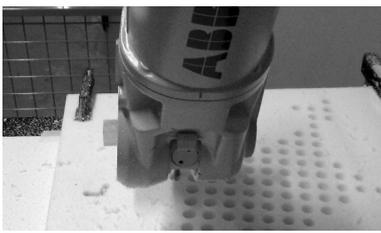
The emergence of a new material practice presents a common problem to design and architecture that provides the strong bond for this project and calls for the redefinition of established experimental approaches. It is the introduction and acknowledgement of digital fabrication processes that installs a new and challenging nearness between design and material (Ramsgard Thomsen 2009) [9]. Design for direct fabrication, for printing, cutting or milling, demands the embedding of a material understanding of details and joints as well as of material performance. Such digital fabrication challenges the traditional understanding of designing as a process of refinement. While not fully reversing this process, working with digital fabrication allows interfacing the crafted and the materialized with the immediate design process.

### Material and Design

The potential of this new address enables designers and architects to make new use of old materials (Tamke 2010)[10] and leads to the speculation about new solutions. What is at stake is not only the systematic control of variation, or even a return to the richness of ornamentation, but equally a fundamental change to the understanding of materials. Rather than thinking materials in pre-made and categorizing manner, as a set of practices that lend themselves to ceramics, steel, textile, concrete or timber, materials are understood from their structural setup. The material itself becomes the site for design that is altered through technology or digitally composed towards a certain performance (Hanna and Mahdavi 2004) [11].

### Experiments in a new design space

In necessarily interdisciplinary collaborations, the grown fields of knowledge from crafts, design, computation, engineering and material science can be integrated through experiments. They allow to reconsider the traditions of crafting (McCullough 1996) [12] and to investigate how new processes can lead to new answers for the complex demands that contemporary architecture and design face (Knippers 2011)[13]. Experiments provide a means to create theoretical and operational knowledge in the new field of material practice in architecture and design. It is here where an experimental practice instigates speculations, which explore the position and friction of direct material engagement and its interface through digital technology.



[8] Picon, Antoine (2010) Digital culture in architecture: an introduction for the design professions. Basel: Birkhauser

[9] Ramsgard Thomsen, Mette, Tamke, Martin (2009) Narratives of Making: thinking practice led research in architecture, in: Proceedings of the Conference Communicating (by) Design 2009, Bruxelles, Belgium

[10] Tamke, Martin, Riiber, Jacob, Jungjohann, Hauke (2010) Generated Lamella, Proceedings of the 30th Annual Conference of the Association for Computer Aided Design in Architecture, ACADIA.

[11] Hanna, Sean and Haroun Mahdavi, Siavash (2004) Modularity and Flexibility at the Small Scale: Evolving Continuous Material Variation with Stereolithography. In Beesley P. Cheng W. and Williamson R Eds. Fabrication: examining the digital practice of architecture. University of Waterloo School of Architecture Press, Toronto.

[12] McCullough, M. (1996) Abstracting craft the practiced digital hand. Cambridge, Mass.: MIT Press.

[13] Knippers, Jan (2011) Digital Technologies for Evolutionary Construction, in: Computational Design Modelling, Proceedings of the Design Modelling Symposium Berlin 2011, Springer, Vienna.

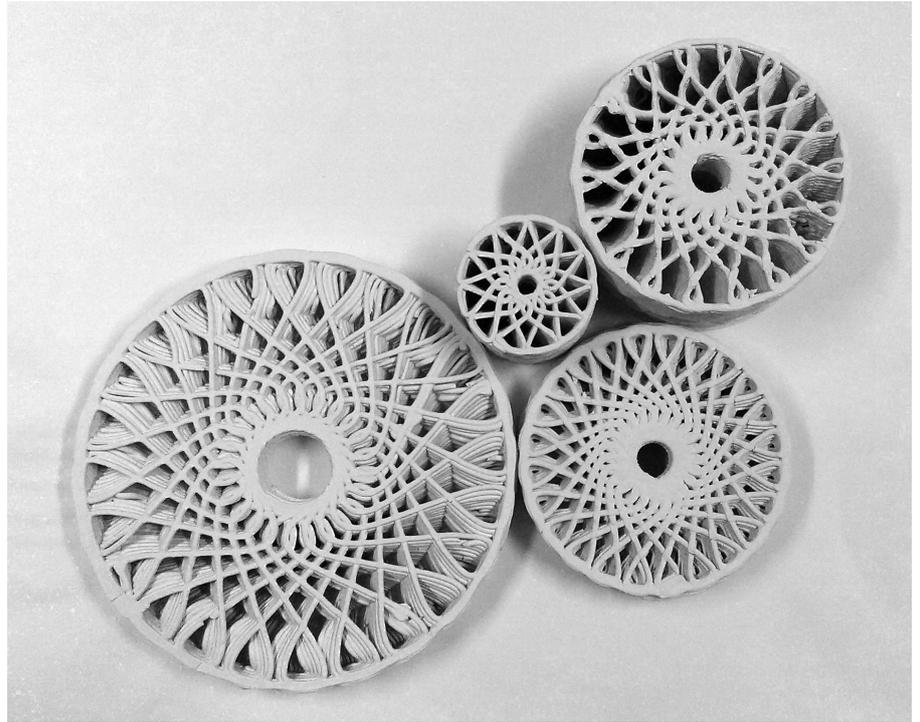


# SENSITIVE CERAMICS

## Interfacing design and making of Ceramics

Flemming Tvede Hansen (SuperformLAB) with Martin Tamke and Henrik Leander Evers (CITA)

Sensitive Ceramics is showing an interactive digital design tool for designing wall like composition with 3d ceramics. The experiment is working on two levels. One which has to do with designing compositions and patterns in a virtual 3d universe based on a digital dynamic system that responds on the movement of the hands. At a certain distance the user's hands appear on a monitor screen as a pattern of circles, which size and 3d inner pattern are reflecting the position and speed of the hand. In that way the user are able to interact and model a responding pattern. The second level has to do with realizing the modules in ceramics by 3d printing directly in porcelain with a RapMan printer that coils up the 3d shape in layers. Finally the ceramic modules are mounted in a laser cut board that reflects the captured composition of the movement of the hands.

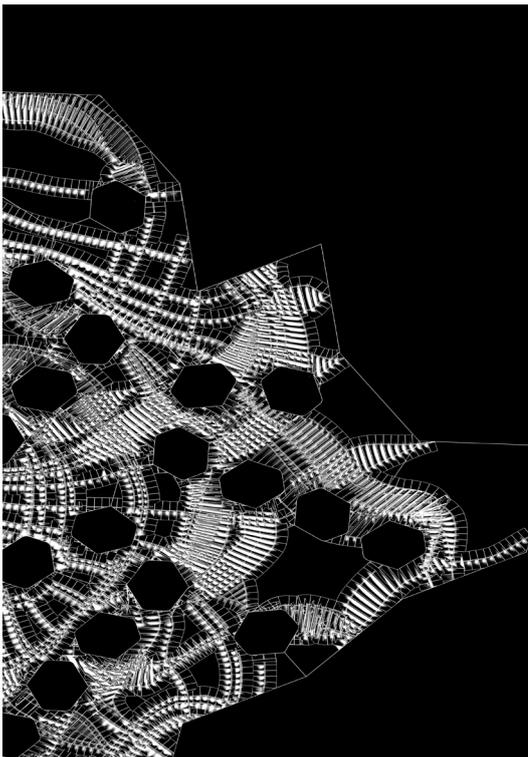


# TRANSMISSIVE ASSEMBLIES



## Basic Material research into integrating material behaviour

Paul Nicholas (CITA) with Jacob Riiber (CITA) and Antonio Scaffidi (Institut for Productdesign, School of Design)



The installation Transmissive Assemblies concentrates upon two qualities that are particular to fibre reinforced composites: translucency in a structural element, and the ability to gain stiffness locally through forming and folding. Taking point of departure from preceding architectural experiments focused upon these qualities - exemplified by Renzo Piano's Mobile Sulphur Extraction Facility (1965) - the project asks how a modern composite sandwich might be designed to modulate the transmission of light in a controlled manner through strategic material variation.

The aim of this experiment is to establish methods for designing with synthetic materials. Practice already possesses models for composites that synthesise the inter-related behaviour of constituent components, but we do not have models for activating and varying these components, and the qualities associated with them, within the design process. What might these models be like, and how do they allow us to think about materialization and specification in new ways?

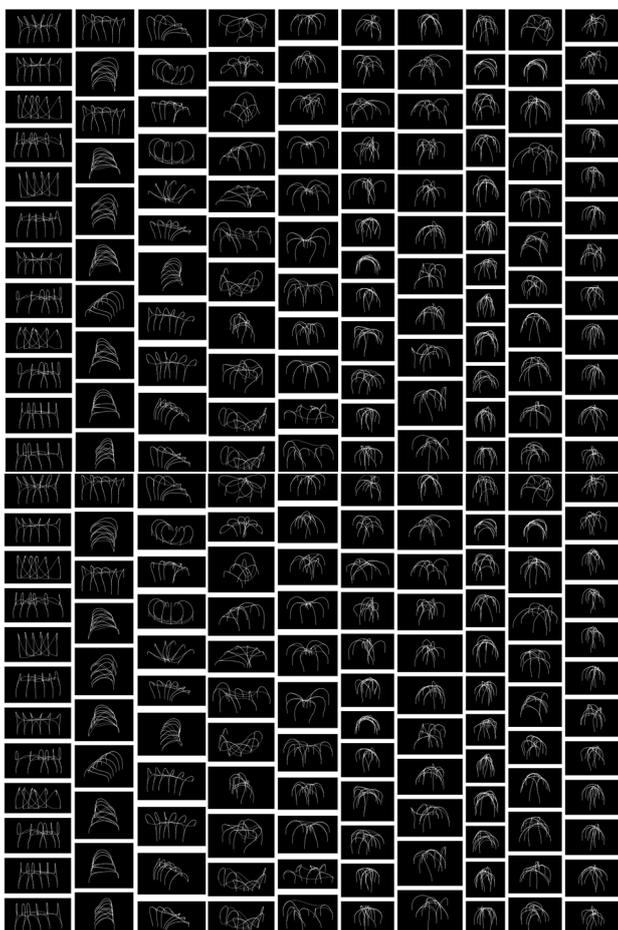
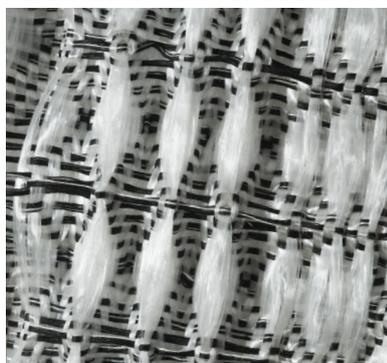


# IN THE MAKING

## Constructed Textiles and Surface Manipulation

Malene Kristiansen and Mary-Ann Hansen (Design School)  
Further financial support by Solarfonden

In the Making aims at highlighting textile design development as an experimental practice carried out within a methodological frame formed by various textile processes. Through explorations of textile materials and technologies the project approaches experimentation and development of aesthetic expressions through material investigation thus forming a platform for reflection through making as an asset to further development within the field of textile design.



# LEARNING TO BE A VAULT

David Stasiuk and Mette Ramsgaard Thomsen (CITA)  
The project is conducted within the Complex Modelling research project of CITA.

Where parametric modelling allows designers to work in flexible ways with variable geometries, the associated problems of parameterisation and reduction are well known. Parametric models are normally limited because they necessitate a pre-configuration of their embedded variables as well as a pre-determination of model topology, meaning that the designer needs to know all defining parameters and relationships between model elements at the start of the design project. "Learning to be an Vault" operates as an experiment that tests new methodologies for the modelling of design systems that challenge

this standard of configuration fixity by opening parameter spaces in both variable value and element connectivity while simultaneously embedding material behaviour within morphogenesis. The aim for the project is to establish methods for designing with open topologies in which the dependencies between parameters are emergent and open to change during the design process. To this end, multiple learning strategies – including evolutionary and unsupervised classification algorithms – are deployed in the interrogation of a broad design space.

This project investigates the role of under-specified models to support adaptive strategies in architectural design. This may at first seem counter-intuitive as the activity of design is generally regarded as aiming towards greater degrees of specificity, especially when focusing upon issues of realisation.

However, under-specified models find real traction as a means for dealing with situations in which there is incomplete information, continual change, unpredictability, uncertainty and the need to manage multiple criteria that are often conflicting – conditions which are endemic to both architectural design and use.

Computational approaches provide a basis for establishing these models, allowing them to continually re-calculate, adapt and exhibit different states in the face of a design context undergoing continual change.

A pneumatically activated tensile skin provides a limited material analogue to the computational space of representation. It has the ability to

change state, expressed through active shading in relation to specific geographical location, time of year and changing interior demand.

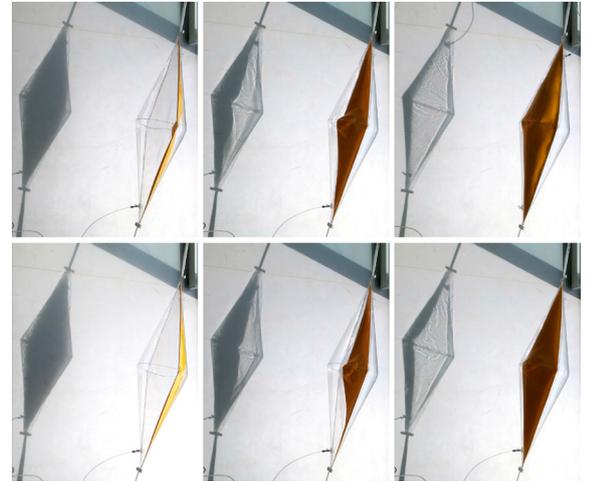
The project draws a critical distinction between the need for high degrees of specificity at the level of material assignment and organisation, and the need to remain under-specified in terms of response to its context. Through the use of under-specified models the system is able to remain provisional over extended time whilst finding specificity 'in-action' at any point in time. The system, which should be understood as a material and computational hybrid, is continually adapting and negotiating the interface between internal demand and exterior environment. It manifests a restless specificity.

## PERSISTENT MODEL III



### Multiscalar shape change

Phil Ayres (CITA) with Hollie Gibbons, David Stasiuk (CITA) and Kasper Stoy (ITU)  
Financial support through the KADK sustainability initiative. Industrial support from Aug. Olsen's Eftf. A/S and FESTO



## REFLECTIVE GROWTH

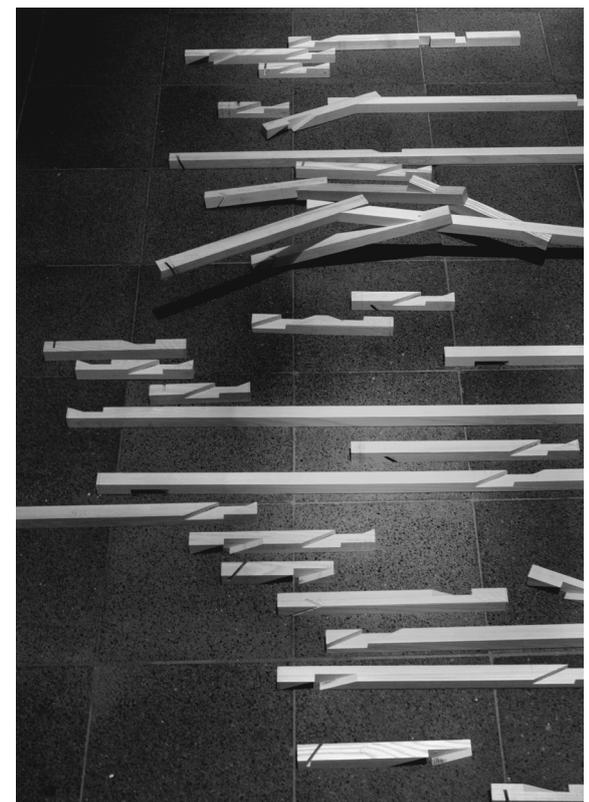
Martin Tamke, Claus Rytter Bruun de Neergaard, Henrik Leander Evers (CITA) with Jacob Riiber (CITA) and Anders Drøidal.  
In collaboration with students and teachers from Copenhagen Technical School (KTS) Clara Linnea Brøndum Heidemann, Gunilla Dueholm Persson, Lucas Brejnholt Neiiendam, Miki Traagaard Seneca, Peter Linnebjerg Larsen, Sebastian Bisgaard Sloth and Jonas Rahim Pedersen.  
The project received further support through the KADK sustainability initiative and sponsorship by SpektraLED.

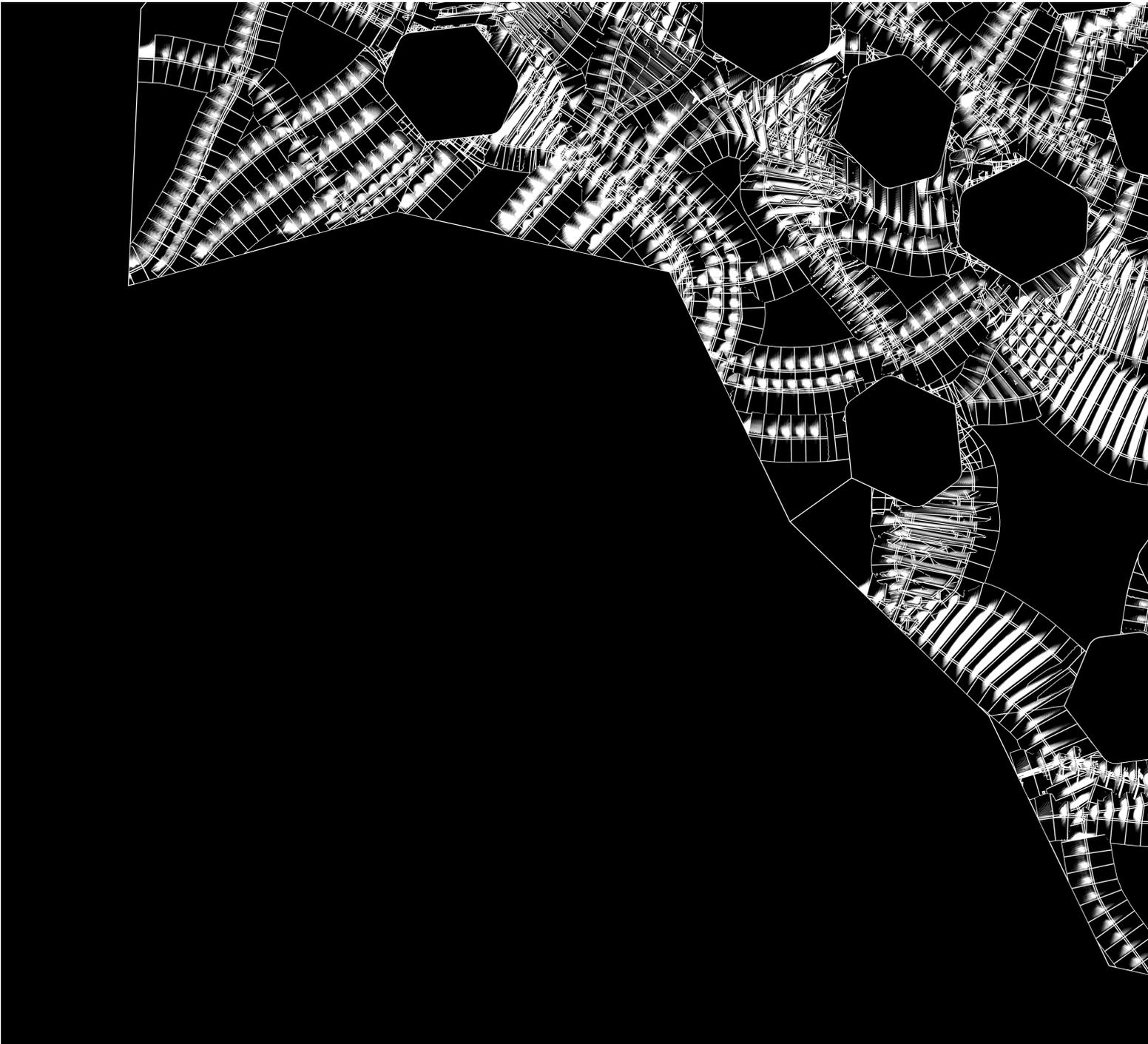
Design can be understood as the negotiation of seemingly non-negotiable constraints.

"How can computational approaches support the process of finding a balance between a complex set of requirements?"; is the question underlying the experiment Reflective Growth.

1. The reflection of light follows a clear rule: Incoming equals outgoing angle. This is the irrevocable outset for an array of mirrors that are programmed to reflect the light of a moving artificial sun to a set of targets.

2. Construction systems with materials as wood find their limit in matter and fabrication. In the installation the knowledge about this is incorporated into a generative design system with feedback loops to simulation. This produces subsequently solely "buildable" solution and allows the design to make use of the benefits of wood joints in self-jigging and fast assembly. The course of the sun is a repeating spectacle and the modulation.





The Royal Danish Academy of Fine Arts,  
Schools of Architecture, Design and Conservation



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