



# buildings of the future

credits: 15 + 7.5  
 duration: Spring 2017  
 grading scale: pass / fail  
 language of instruction: English  
 parallel participation in other courses: ASEN15 required. (Students without prior knowledge in parametric software should consider taking AAHN15 [CreativeTools] in parallel to this course.)  
 eligible to apply: At least three years approved full time education at university level (or a Bachelor degree) in architecture, or equivalent.

course coordinator: David Andreen  
 david.andreen@arkitektur.lth.se  
 teaching team: David Andreen, Ana Goidea + external lecturers, assistants and workshop leaders

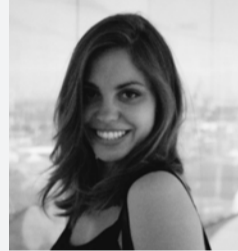
David Andréen

David is currently completing his doctorate at the Bartlett UCL, where he explores architecture and its intersection with biology and computer science. David is a lecturer at Lund since 2014, and has previously taught at the Bartlett GAD programme, at Greenwich University, and has held workshops at Smart Geometry and CITA, Copenhagen.



Ana Goidea

Ana is a graduate of the Royal Danish Academy of Fine Arts, where she was part of CITAstudio programme. Previously she studied at Politecnico di Milano and Ryerson University. Her research focuses on material science and digital fabrication, particularly 3d printing technologies.



Olof Jansson

Olof is an industrial designer with a speciality in ceramics and fabrication, and will provide specialist expertise in his areas.

Lars-Henrik Ståhl

Lars-Henrik is Professor of Theoretical and Applied Aesthetics, and the examiner of the course.

## Overview

The studio Spatial Experiments (composed of one autumn and one spring studio course) is dedicated to exploring emerging new technologies, processes and possibilities in architecture. We explore the changing role of the architect in face of a multitude of new digital tools, both for fabrication and design, which open up new pathways to sustainable, functional and delightful architecture. In the first semester, the course which predates the one described here, we engaged these issues through buildings in an extreme environment: the Moroccan desert. We looked at materials, shape, generation and fabrication, and are inspired by biological and vernacular precedent. This semester, the course Spatial Experiments II will take these explorations further in a European context, which builds on the knowledge collectively gained in the previous course (it is open to both new and continuing students.)

In the spring course, you will be tasked with designing a house meant to be fabricated through additive fabrication, or 3D printing. While such technologies are still experimental at the scale of architectural construction, development is rapid and the prospect no longer unrealistic. Through lectures, study trips, literature and own research, you will build an understanding of the possibilities and constraints of these technologies, and formulate a context for designing a prototype home.

We place a special emphasis on the function, logic and generation of geometric and spatial complexity, in order to understand why such a building is interesting to contemplate. The

theory course, which is conducted as an integrated part into the design course, allows you to gain a deep understanding of additive technologies, their constraints and possibilities, as well as exploring the theoretical arguments made about the future of architectural design.

## Pedagogy

Our pedagogy is based on the expectation that students are independent and motivated and that you will bring your own agenda, interests and experience, and explore how this intersects with the studio.

You are ultimately empowered and responsible for defining your own project and to carry it through, and we will give you the support, input, and encouragement you need to get there. We believe in sharing and contributing, and see the studio not as a collection of competing, individual students, but as a group that explore interesting phenomena together.

We hope that each year's students will build on what has been done before them, and that your work contributes to an ongoing conversation as well as allowing you to form the beginning of your own professional career.

## Tools

Though the primary emphasis is on architecture, not software or hardware, we work extensively with parametric design tools and try to fabricate and test as much as we can. Primary software is Rhino 3D and Grasshopper 3D, and we encourage any students who wishes to take the opportunity to learn or use more advanced coding tools such as Processing.

## Deliverables and project form

The primary presentation is the end of year review, where your project is presented in poster format. We will also expect a A3 / A4 format report with a greater focus on the research and theory aspects of the project. Specific project deliverables will be your responsibility to determine, with the input from tutors. We will however expect a thoroughly presented, well designed architectural output, with a significant level of detailing and resolution.

The work will be exhibited at the school's Spring Exhibition. This is part of the course deliverables, and you are expected to prepare your own work as well as setting up the studio exhibition.

You are expected/encouraged to work in pairs, as the course places high demands on both theoretical content and architectural resolution, and teamwork will help you achieve a much stronger project in the end. The form of the teamwork and the degree of overlap is up to you.

## Study trip

In February/March we will travel to England as part of the course. While this is not mandatory, students are strongly encouraged to join the trip!

## Literature, lectures and workshops

A literature list will be provided, and you will be expected to conduct significant research into your individual topics. Lectures, by both internal and external lecturers, will be provided during the course to support the student projects.



## BRIEF

# additive fabrication

The brief for the studio *Spatial Experiments II* will deal with the challenges and opportunities of additive fabrication techniques. Your task will be to design a dwelling - a place for a group of people to live in - in central Copenhagen.

This building will sit in a complex urban context, and you will be expected to develop a project which challenges, questions and proposes what a building

in an urban context can do in the future. The potential consequences of emerging digital fabrication and design techniques are enormous, and may lead to new interpretations of local/global, private/public, inside/outside, and other dichotomies, as well as challenging current interpretations and expressions of identity, culture and aesthetics.



The site: Kødbyen in Vesterbro. Photo from kontraframe.dk via www.mimoo.eu /

### Site

The site for the project is Kødbyen: the area is bounded by the city's railway tracks in the south east and the neighbourhood of Vesterbro to the north west. During spring and summer, the district hosts one of the city's large food markets, and while retaining its own strong character throughout the year it accommodates a variety of uses.

The old meatpacking district in Copenhagen has been recently transformed into a vibrant hub in the city. Cafes, restaurants, bars and nightclubs took over the meat industry buildings. And although in some parts the original function is still kept, the district has become a creative cluster housing a theatre, galleries, performance venues, exhibition spaces, studios and architecture firms.

### Technology

The ambition of the studio is to explore the potential of advanced digital fabrication tools, particularly additive fabrication. We will explore what it means to design for additive fabrication (3D printing) at a large scale: how does the design process change? What new possibilities arise? How can we make the most of this technology, from a social, cultural and ecological perspective?

The course will require an inquisitive mind and a willingness to test, experiment, and fabricate. We learn about technologies not for their own sake, but in order to seek out the consequences for our profession as well as society at large.

Each student/group will decide the focus of your investigation, proposing a hypothesis which you investigate, demonstrate, and test during the course of the term.

### Programme

The studio embraces a fundamentally optimistic view of architecture, believing that technology, knowledge and intelligence can come together to overcome typical dichotomies, such as comfort vs sustainability, technological progress vs fairness. Rather than a critical, external viewpoint, we embrace *operative optimism*, believing that a willingness to engage and to commit is crucial for beneficial change.

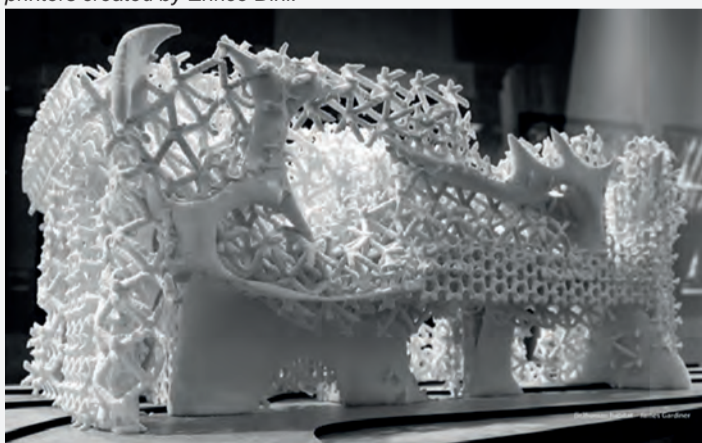
The brief programme is about *living*. You determine the circumstances.



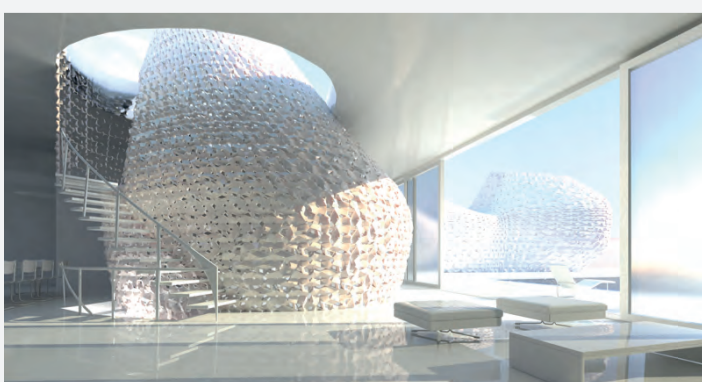
D-Shape printer - one of the first functional construction scale 3D printers created by Enrico Dini.



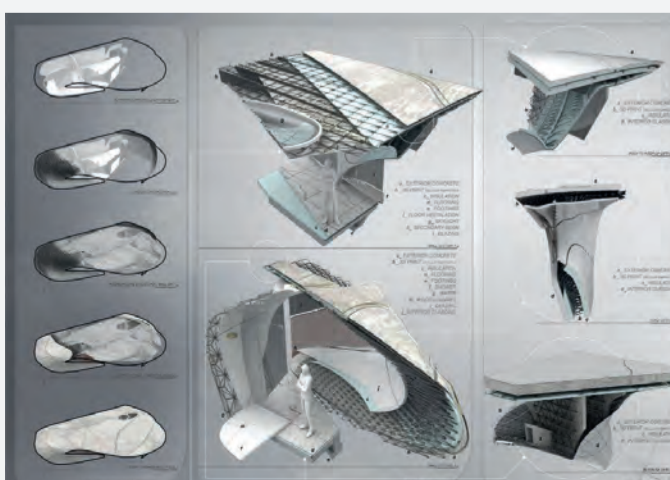
"Quake Column" by Emerging Objects



(in)Human Habitat by James Gardiner. Design for an artificial reef intended for additive fabrication.



Design by Emerging Objects for a partly 3 printed house in Beijing.



Detail from winning proposal for Freeform Home Design Challenge competition, "Curve Appeal" by WATG Chicago. The competition was arranged by Branch Technology to showcase the design potential for their freeform construction technology.



STUDY TRIP / SITE

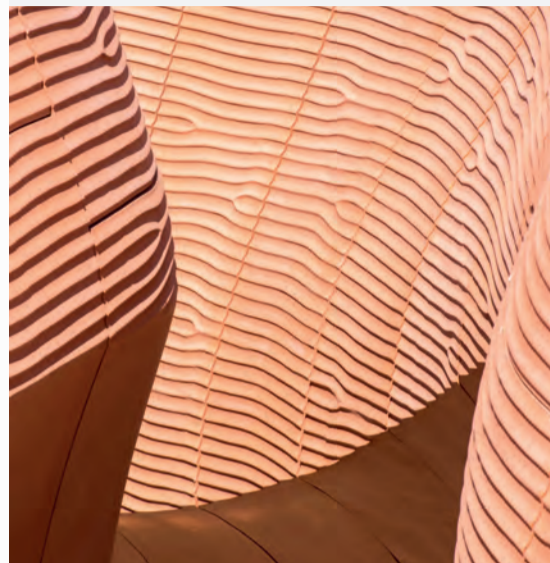
# London/England

**Preliminary dates:**  
End February-early March

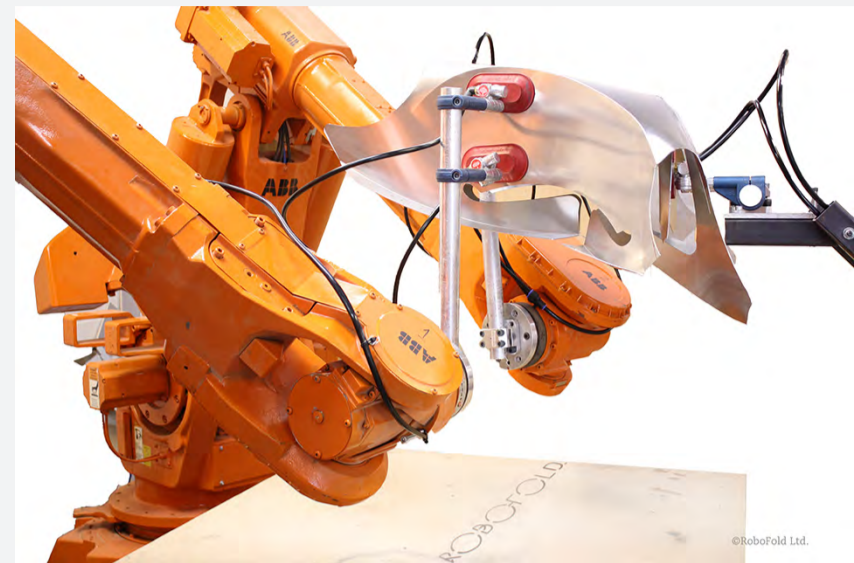
**Preliminary Programme:**  
We travel to London where we visit some of the architectural studios and practices which are currently driving the digital narrative forward, including design studios, fablabs, startup companies, and large practices.

After London, we travel up North to visit some of the large academic and industrial initiatives seeking to develop large scale 3d printing production.

The final stop of the trip will be the Functional Ceramics group in Nottingham Trent University, where we have a hands-on workshop with a FDM ceramics printer.



Foster & Partners



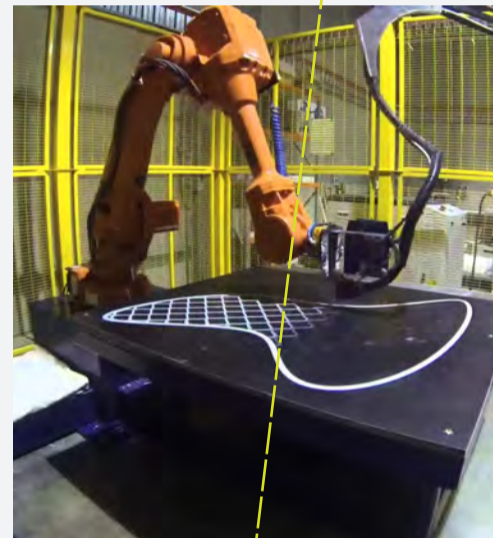
RoboFold



Grymsdyke farm, workshop



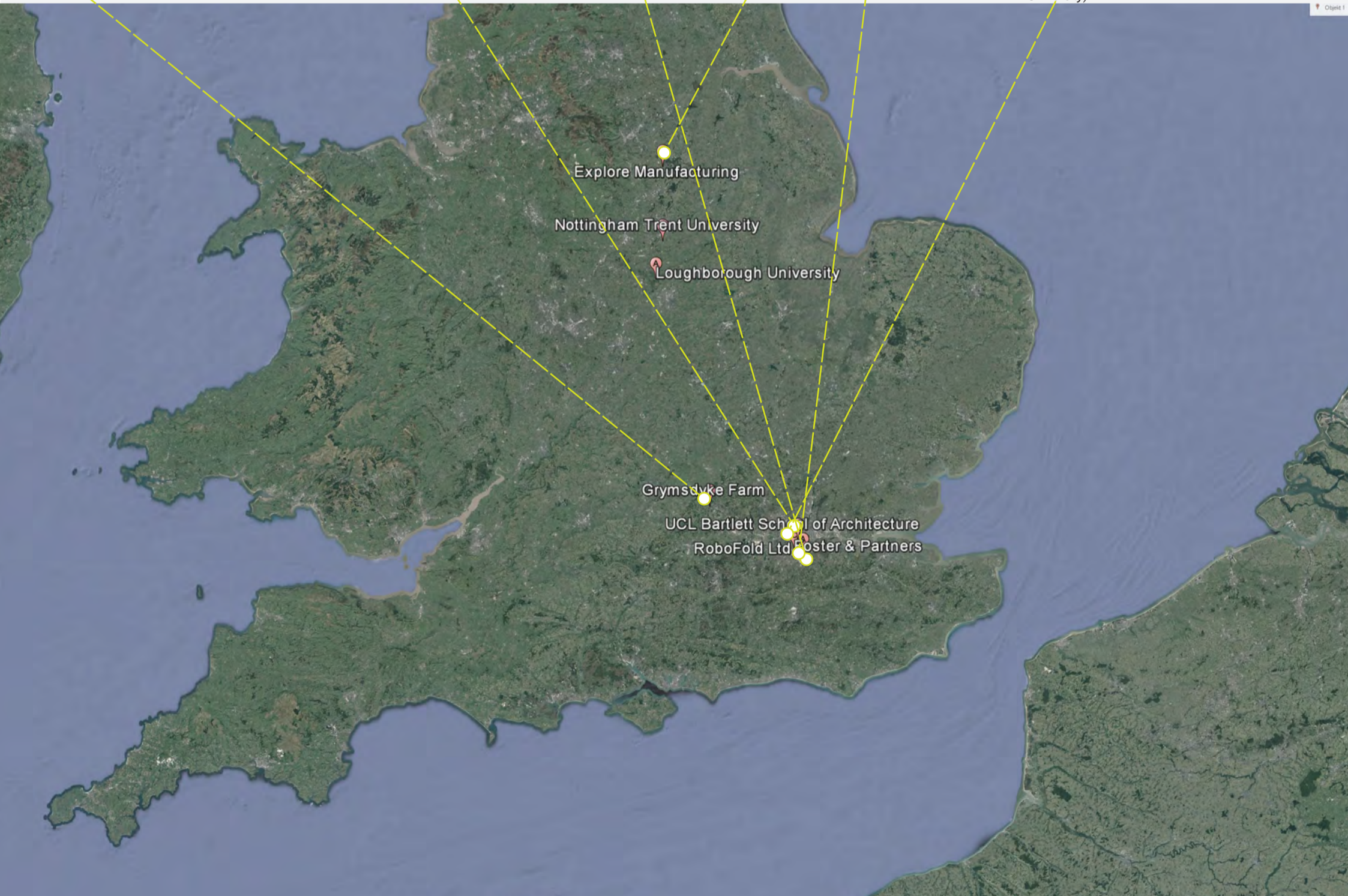
UCL Bartlett, B-Pro Master's programme



Freefab, Laing O'Rourke



Arthur Mamou-Mani, [wewanttolearn.net](http://wewanttolearn.net) (Westminster University)





# 3d printing and computational design

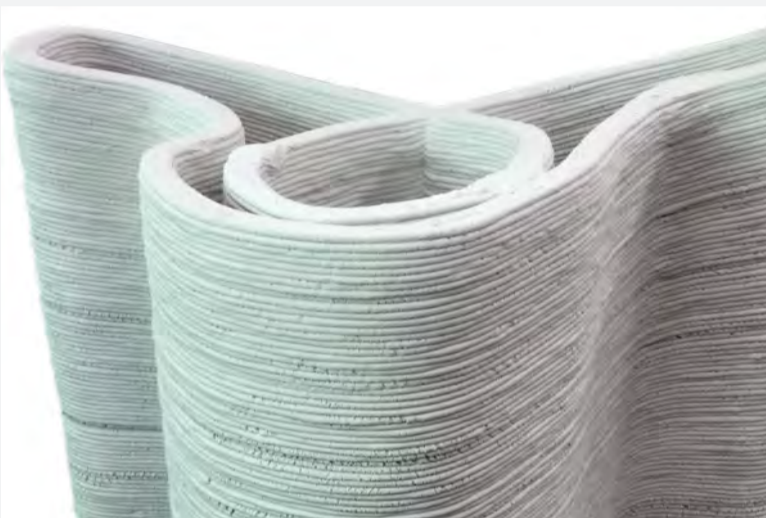
The supporting theory course for the project Spatial Experiments II is conducted in an integrated manner, providing a research background and rigorous approach to the design projects. The topic of the investigation is large scale additive fabrication technologies, how these work, and how they change and inform the design process.

We will look into the ongoing research and commer-

cial efforts in the area, what designs are currently being proposed, and what tools we need to master in order to deal with these challenges and possibilities.

Of particular interest is the idea of complexity of form and mass customisation which is made possible by additive fabrication. What can this complexity be used for? How do we generate

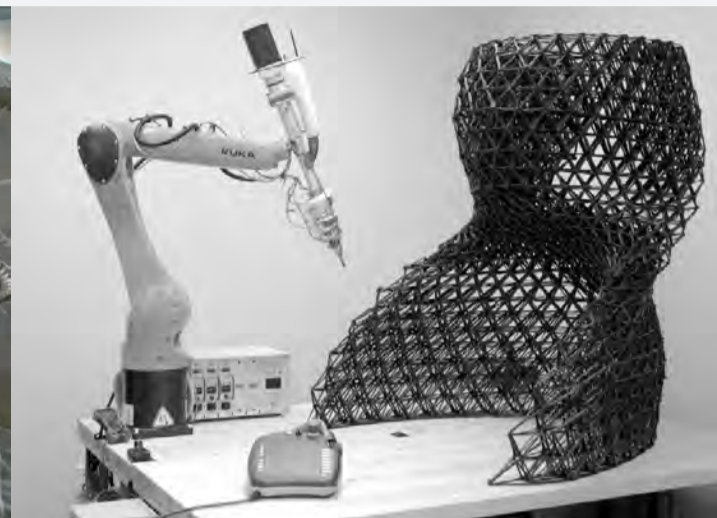
control, and inform it? What are the stylistic and aesthetic consequences that follow?



3d printed concrete at MX2016, by www.bruiil.nl



Exhibition installation at ARCHILAB 2013 – Naturalizing Architecture, FRAC Centre, Orleans France by Richard Beckett



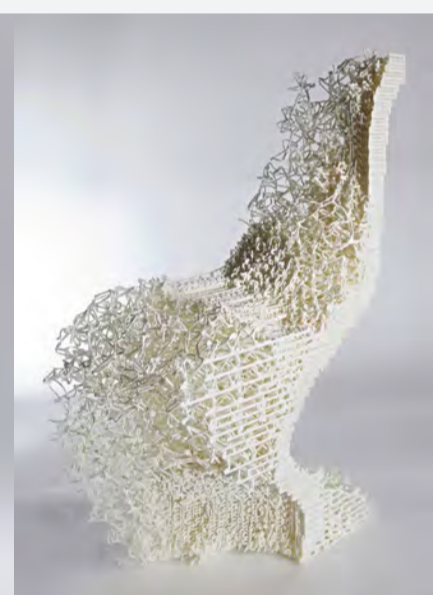
Additive wall system by Branch Technology



STL print computed through CUDA parallel processing, by Daghm Cam.



Sculpture by Daniel Widrig



CurVoxels chair, 3d printed by students at Bartlett B-Pro cluster 4.



Arabesque Wall by Dillenburger and Hansmeyer