

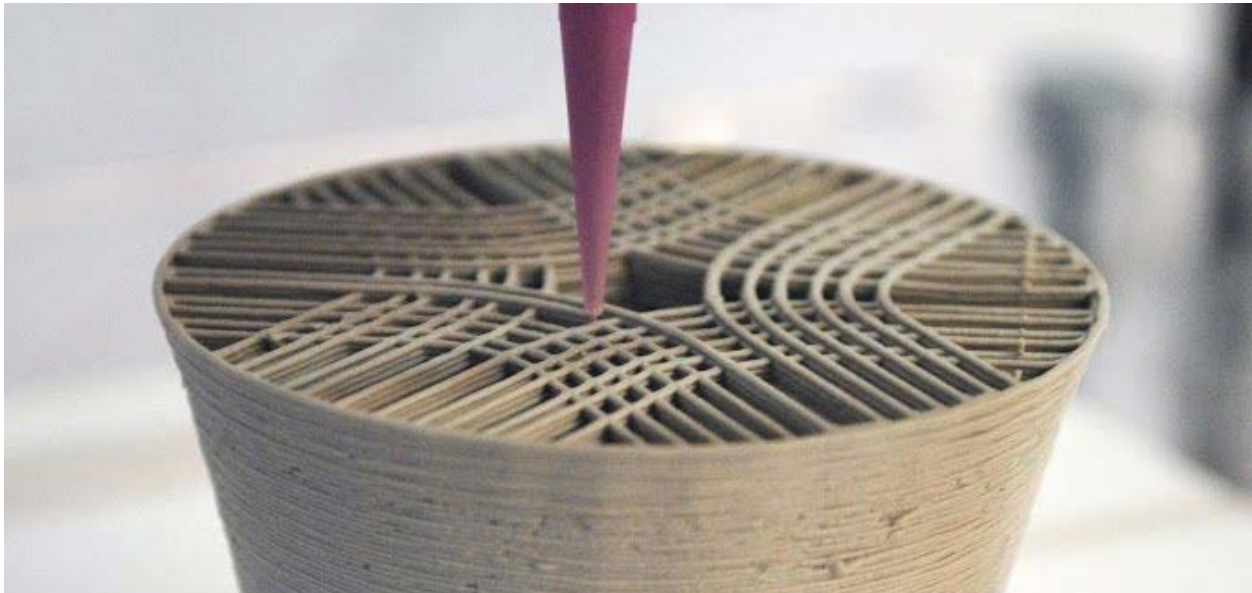
SYLLABUS --- ARCHT-570/670

Instructor: Jason Kelly Johnson (jjohnson2@cca.edu)

Mondays 12:00PM - 2:50PM

SF Main Campus, Room S1 Digital Craft Lab

3d Printing and Additive Manufacturing in Architecture



(credit: "printing intersecting lines" by studio unfold)

"The joint, that is the fertile detail, is the place where both the construction and the construing of architecture takes place." - Marco Frascari, "The Tell-the-Tale Detail"

"Workmanship engaged us with both functional and aesthetic qualities. It conveys a specific relation between form and content, such that the form realizes the content, in a manner that is enriched by the idiosyncrasies of the medium." – Malcolm McCullough, "Abstracting Craft: The Practiced Digital Hand"

"I think the combination of robotic construction and 3D printing is the future of the building industry. It gives the architect more freedom to invent. The ideas that right now are killed, by the argument that it costs too much or it takes too long, will be not killed anymore." –Architect Wolf Prix, Coop Himmelb(l)au

The seminar will explore the theoretical and technical implications of 3d Printing and Additive Manufacturing in the world of architecture, design and digital craft. Special emphasis will be placed on exploring speculative techniques related to design and computation, emerging computer-aided-manufacturing techniques and material explorations. We will explore a variety of applications and scales ranging from wearable architectures, furniture, buildings and landscapes.

We'll re-consider the iconic details of modern architecture in light of emerging 3d

printing technologies used in conjunction with new software paradigms. The modernist era was marked by tectonic expressions ranging from the wood joints of Wright, Aalto and Schindler, to the exquisite connections of Le Corbusier and Mies, to the fluid vaults of Saarinen, Candela, Utzon and more. These pre-digital construction details – whether machine-made or hand-crafted, mass-produced or singular - reveal the spirit and practice of their time. These architects – in dialogue with craftsman, technologists and theorists – shaped their era through a deep understanding of history, their contemporary condition, and an experimental spirit.

Similarly – what are the new possibilities opened up by 3d printing? How will these technologies change how we think, theorize and make architecture in the future? What are the aesthetic, social, cultural, ecological implications? What is the future of the architectural detail in the age of 3d printing and additive manufacturing?

The seminar will be organized into three distinct phases:

Phase 01: Research (4 wks)

- learn to use a range of 3d printing software, machines, processes
- complete a survey of technologies past, present, future
- identify modern architectural precedent details to explore
- execute simple 3d printed details in multiple materials

Phase 02: Experimentation (4 wks)

- explore work flows to translate precedent details
- invent and iterate through multiple design possibilities
- establish research agenda to structure Synthesis phase
- execute multiple 3d printed details in multiple materials using generative techniques

Phase 03: Synthesis (4 wks)

- work with a partner to develop an ambitious final project that deepens and expands Phase 1+2 research and experimentation.
- execute 3d printed artifacts and drawings for final seminar exhibition
- execute final 3d printed detail model in multiple materials using generative techniques, and complete drawings and text illustrating the process and potential



(credit: "freeform polymer printing" by IAAC; "concrete house printing" Winsun, China)

Software

Focus: Algorithmic and Generative Architectures, Minimal Surface structures, Radiolaria, Growth patterns in organic lifeforms, Aggregate forms, Gradients, Experimental Design Interfaces, Lattice Structures, more

Grasshopper3d + Grasshopper Primer: <http://grasshopperprimer.com/en/index.html>

Project Silkworm for Grasshopper: <http://projectsilkworm.com/>

Meshmixer by Autodesk Research: <http://meshmixer.com/>

Makerbot Desktop: <http://www.makerbot.com/desktop>

Replicator G Open Source: <http://replicat.org/>

Hardware

Focus: Machine Processes, Open Source Machines, Hacking, Deposition, more

Flashforge Creator Pro 3d Printer: <http://www.flashforge-usa.com/creator-pro/>
(You will have access to two of these printers in the Digital Craft Lab)

Makerbot Replicator Mini: <http://www.makerbot.com/>
(You will have access to four of these printers in the Digital Craft Lab)

Linear Ram Extruder: <http://www.deltabots.com/products/3d-clay-extruder>
(You will have access to this clay extruder to be used in conjunction with [DCL Gantry](#))

Rapid Prototyping Studio 3d Printing Resources:
<https://www.cca.edu/about/administration/studio-resources/rps>
(You can submit file to be printed on CCA's ZCorp and Objet 3d Printers)

Materiality

Focus: Material Science, Phase Transitions, transformations, multi-materiality opportunities, Scale, Strength to Weight, Sustainability, Fiber, more

Plastics, Polymers, Clay, Concrete, Metal, Wood, Glass, Carbon Fiber

Misc Resources

Focus: New Business Models, File Sharing, Intellectual Property, Mass Customization, more

3d Object Repository: <http://www.thingiverse.com/>

Commercial 3d Printing – fast and cheap: <http://www.shapeways.com/>

Commercial 3d Printing – fast and cheap: <https://www.ponoko.com/>

Grading and Attendance:

You will primarily be graded on the level and quality of your participation in studio activities including discussions, workshops and field trips. You will be asked to complete weekly assignments and participate in all informal pinups and formal reviews. The assessment of letter grades will be calculated as follows:

(25%) Class Discussions, Participation, Attitude

(25%) Midterm Progress

(50%) Final Project and Presentation; final documentation submission

Definition of Grades: A = outstanding achievement—significantly exceed standards; B = commendable achievement—exceeds standards; C+ = minimum acceptable achievement—meets standards; C or D = below standards; F = failing

Strict Attendance Policy: All scheduled class meetings are mandatory. If you miss more than two seminar sessions you will be given the letter grade F without exception. Nevertheless, if you are going to be late, or need to miss a session due to illness or misfortune, simply contact me!



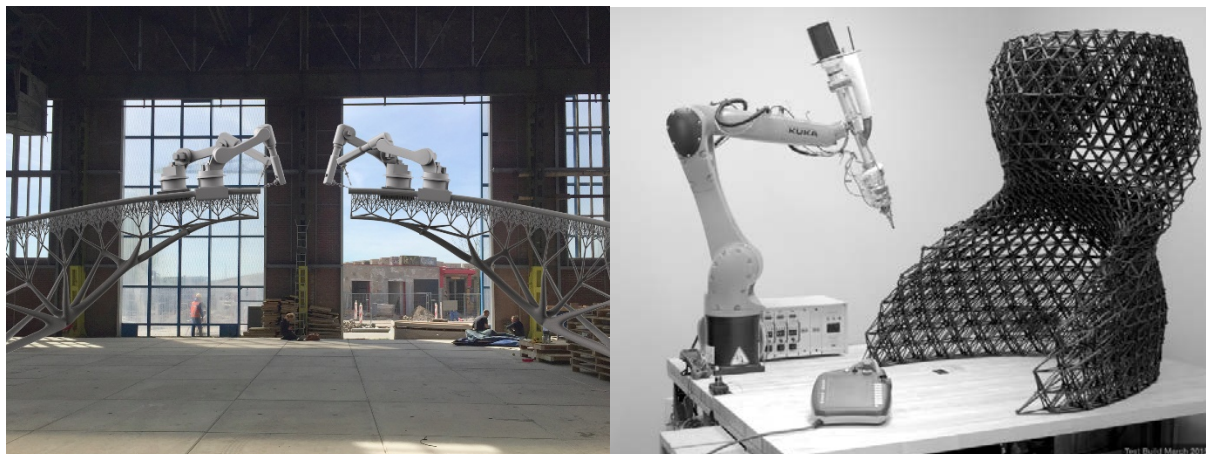
(credit: "golden domes" by Cero9; "clay prototypes" by Unfold Studio)

Readings + Other Materials

Weekly readings in PDF format will be shared with you using Google Drive. A reading will be assigned to you each week.

Recommended Book: *Printing Things: Visions and Essentials for 3d Printing* (co-edited by Dries Ver Bruggen and Claire Warnier, Gestalten Press, 2014)

Materials: Please purchase 2 roles of filament – White PLA and Black ABS.



(credit: "steel bridge" by MX3d; "lattice structures" by Branch Technologies, TN)

ARCHT-570/670 Spring 2016 Schedule

* In addition to schedule listed below we'll have several guest speakers and at least one field trip.

RESEARCH	
Week 1	Mon 1/25 - Syllabus and Introductions, Resources
Week 2	Mon 2/1 – – Lecture / Workshop
Week 3	Mon 3/14: Open Lab (no formal class)
Week 4	Mon 2/15 – Lecture / Workshop *** 3d Printed Detail 1 Due ***
EXPERIMENTATION	
Week 5	Mon 2/22 – – Lecture / Workshop *** 3d Printed Detail 2 Due ***
Week 6	Mon 2/19 – – Lecture / Workshop *** 3d Printed Detail 3 Due ***
Week 7	Mon 3/7 – – Lecture / Workshop *** 3d Printed Detail 4 Due ***
Week 8	Mon 3/14: Open Lab (no formal class)
Week 9	3/21: Spring Break
SYNTHESIS	
Week 10	Mon 3/28 – – Lecture / Workshop *** 3d Printed Detail 5 Due *** (Theo Spyropolous Lecture 7pm)
Week 11	Mon 4/4 – – Lecture / Workshop *** 3d Printed Detail 6 Due ***
Week 12	Mon 4/11 – – Lecture / Workshop
Week 13	Mon 4/18 – – Lecture / Workshop
Week 14	Mon 4/25: Final Project Presentations *** Final 3d Printed Detail Due ***