

ARCH 631 D³ Detail + Data + Delivery Research, analysis, and integrated technologies for AEC project delivery

Contact information

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Office hours - available to meet with 24hr lead time

Teaching Fellows

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Lectures

Wednesday 10.15 am - 11.45 am

Claire Fagen Hall AUD, Ann L. Roy Auditorium

Guest lectures will be delivered virtually.

COURSE DESCRIPTION:

- Field:** This course is focused on advanced subjects in the project delivery of buildings: subjects inclusive of **Building Organically with Carbon Responsive Materials and Details, Resiliency and Fossil Fuel Free Building Systems Integration, Construction Robotics and Advanced Prefabrication, and Artificial Intelligence, Digital Delivery, and Building Simulations**. Students study complex, integrated, and sustainably determined buildings seeking their systems based, technological, and labor-based innovations.
- Method:** Students engage in **advanced research methods and forensic analysis of artifacts** associated with the material detailing, fabrication, data-scaping, virtualizing, simulating, and workflow planning of building projects. Students also organize the collection of firsthand/primary source information by interviewing members of the project delivery team. Identifying how, why, and to what end products and practices are deployed in the construction of innovative projects is the goal.
- Sources:** Using research publications, construction documentation, building information models, fabrication shop drawings, construction site photos, analytical models (structure, energy, sun, wind, materials), and data created for and by the construction process, **students analyze, report-on, and critically evaluate important technological innovations** in the delivery of building projects in the AEC (Architecture, Engineering, and Construction) industry.
- Agency:** **Cultivating critical decision-making skills in service to the means and methods of building delivery** remains an essential aspect of the architect's work. Having advanced knowledge of project delivery material technologies, systems, and digital interfaces facilitates the translation of one's design ideas into building; it also encourages a more ethical response to their use. D³ Detail + Data + Delivery asks students to critically assess the responsibility that we have as architects to define, use, and deploy technology in the building of our projects.

COURSE OBJECTIVES:

- **Acquire knowledge and information** associated with the detailed design development, construction documentation, material prototyping, fabrication, and project delivery portions of the architectural practice.
- Conduct **forensic research and rigorous analyses** of building projects, fabrication technologies, material processes, data structures, software, delivery sequencing, and construction management workflows.
- Deploy **networking strategies** for harvesting primary sources related to selected construction projects
- Scheduling, organizing, conducting, and transcribing a **first-person interview** with a project delivery team member in the A, E, or C, for the purposes of finding primary source information.
- Gain exposure to a variety of built/constructed examples of innovative, yet complex, **project delivery workflows, via presentations by invited guests.**

COURSE METHODS

Lectures: Franca Trubiano will lecture on the following subjects:

Lecture Intro	Innovation, not Invention Collaborative Design and the Composite Mind, Walter Gropius and Ove Arup Workflows in Project Delivery
Lecture 1.0	Building Organically with Carbon Responsive Materials and Details
Lecture 2.0	Resiliency and Fossil Fuel Free Building Systems Integration
Lecture 3.0	Construction Robotics and Advanced Prefabrication
Lecture 4.0	Artificial Intelligence, Digital Delivery, and Building Simulations

Invited Guest Presentations

Students will be introduced to advanced topics in project delivery offered by invited speakers in material research, façade engineering, pre-fabrication, and architectural detailing. Students prepare questions for our guests. See details below.

STUDENT DELIVERABLES

(submitted via Canvas and Penn BOX)

1. Readings and Responses

Students will complete [3] reading responses to the subjects covered in the classes' designated readings. Students are expected to offer critical observations and pose rigorous questions that demonstrate their advanced apprehension and comprehension of subjects discussed.

2. Questions for our Guests

In advance of [3] guest presentations, students will review content offered by guest presenters and prepare [2] questions for each guest presentation. Students are expected to identify critical ideas in their questions that challenge the content.

3. TEAM Research and Analysis, Report and Paper

This course deliverable produced by students working in teams of (3), analyzes an exceptional case study in building technology and project delivery. Students focus on how designs are translated during the Detailed Design, Construction Documentation and Fabrication phase of the project. Project details are collected and harvested from our collective professional connections with student teams encouraged to make early connections with professionals involved in the project's execution. An extensive Research Report in the form of a written and diagrammed paper describes and discusses the project's givens and the **team's research question**. The student will use mapping, data collection, modeling, simulation-analysis, and fabrication evidence to demonstrate their claims about the project, including its assets, values and possibly its drawbacks. Exceptional reports will be recommended for publication.

Research questions may be inspired by the content delivered during the instructor lectures or guest lectures. Student teams may also identify their own research topics as particular to chosen projects. In all cases, teams review their research topics with their designated Teaching Fellow.

DETAILED CALENDAR: (Subject to change to accommodate guest speakers)

MODULE

WK1	August 31st	Initial Syllabus Review TA introductions, Syllabus Review, Canvas Site Review What is Architectural Research? A Tale of Two Towers
WK2	September 7th	FT Lecture – Intro <i>Innovation, not Invention</i> <i>Collaborative Design and the Composite Mind, Walter Gropius and Ove Arup</i> <i>Workflows in Project Delivery</i> Final Project Selection by Teams, due
WK3	September 14th	FT Lecture 1.0 - Building Organically with Carbon Responsive Materials/Details Reading Response 1, due
WK4	September 21st	FT Lecture 2.0 – Resiliency and Fossil Fuel Free Building Systems Integration Reading Response 2, due
WK5	September 28th	FT Lecture 3.0 - Construction Robotics and Advanced Prefabrication PART 1 Project choice and research question, due
WK6	October 5th	NO LECTURE Review of PART 1 DEFINITION, Meetings with Teaching Fellows (Team meetings)
WK7	October 12th (Studio mid-terms)	Guest Lecture Gawon Shin, Senior Associate, SHOP Mass Timber Questions for Guest 1, due
WK8	October 19th	Guest Lecture Keyan Rahimzadeh and Evan Levell, Front Inc. Façade Engineering PART 2 INVESTIGATION: Collecting the Evidence, due
WK9	October 26th	FT Lecture 4.0 - Artificial Intelligence, Digital Delivery, and Building Simulations Reading Response 3, due
WK10	November 2nd	Guest Lecture, Bowen Qin, Archi_Tectonics and Kelvin Wang, ZIAD Questions for Guest 2, due
WK11	November 9th	Guest Lectures, Dr. Anne Beim, Royal Danish Academy of Art. PART 3 ANALYSIS: Describing and Analyzing the Evidence, due
WK12	November 16th	GUEST Lecture, Dr. Stefanie Weidner, Director of Sustainability, Copenhagen, Werner Sobek Questions for Guest 3, due
WK13	November 23th	NO class – due to Thanksgiving Week
WK14	November 30th	Final Team Videos and discussion
WK15	December 7th	Final Team Videos and discussion
	December 20th	PART 4 CRITIQUE: Final Submission that Evaluating the Evidence, due

INVITED PRESENTATIONS:

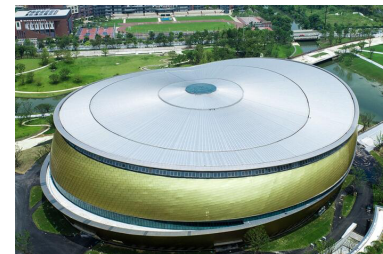
October 12th Detailing Mass Timber, SHoP Projects in LA and Syracuse
Gawon Shin, Senior Associate, SHOP ,
<https://www.shoparc.com>



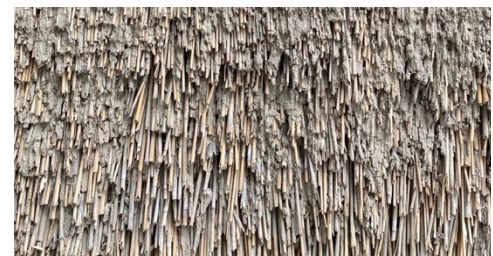
October 19th Design and Automation for Manufacture and Assembly: A Case Study of Scale and Complexity in the Delivery of High-Rise Building Envelopes
Keyan Rahimzadeh, Senior Associate, FRONT, www.frontinc.com/



November 2nd The management strategy of BIM application in Asia Games Stadium
Bowen Qin, Archi -Tectonics, www.archi-tectonics.com
Kelvin Wang, BIM general consultant of ZIAD, <http://en.ziad.cn>



November 9th Building with Organic Materials – Thatch and Hemp
Dr. Anne Beim, Royal Danish Academy of Art



November 16th Resource Minimized Construction
Dr. Stefanie Weidner, Director of Sustainability, Copenhagen, Werner Sobek
<https://www.wernersobek.com>



REQUIRED READINGS:

- **CANVAS Readings** – required topical readings will be posted to the respective **MODULES** for each **WEEK**. In addition –
- Franca Trubiano (2017) "Representing the Visible on Engineering the World: Ove Arup and the Philosophy of Total Design, Victoria and Albert Museum, London," *Technology/Architecture + Design*, 1:1, 121-125, DOI: 10.1080/24751448.2017.1292807
- Franca Trubiano (2019) "Walter Gropius & Ove Arup: collaboration, 'total design' & the 'composite mind.'" *Proceedings of ICSA Conference*, Lisbon Portugal July 2020. [on Canvas]
- What is Architectural Research (posted to Canvas)
 1. Jeremy Till, "Architecture Research, Three Myths, One Method (2007).
 2. Richard Budy, "The Confused and Impoverished State of Architectural Research (2017), <https://commonedge.org/the-confused-and-impooverished-state-of-architectural-research/>
 3. Michael Mehaffy & Nikos Salingaros, "Designers Don't Get Science (And That's A Dangerous Thing)" (2013), <https://www.archdaily.com/391794/designers-don-t-get-science-and-that-s-a-dangerous-thing>
- Phillip Bernstein, *Architecture Design Data: Practice Competency in the Era of Computation* (2018, Birkhauser Verlag GmbH). E Book Central Book that can be downloaded from UPENN Library
- Jane Burry, Jenny Sabin, Bob Sheil, Marilena Skavara, *Fabricate 2020, Making Resilient Architecture* (UCL Press, 2020) JSTOR Open Access
- Richard Garber, *BIM design: realising the creative potential of building information modelling*, (Chichester, England: Wiley, 2014). E Book Central Book that can be downloaded from UPENN Library
- Richard Garber, *Workflows: expanding architecture's territory in the design and delivery of buildings* (Oxford: John Wiley & Sons, 2017). Pertinent articles were downloaded from UPENN Library
- Randy Deutsch, *Data-driven design and construction: 25 strategies for capturing, analyzing, and applying building data* (Hoboken, New Jersey: Wiley, 2015). E Book Central Book that can be downloaded from UPENN Library
- Randy Deutsch, *Convergence, The Redesign of Design*, (Wiley, 2017). E- Book Central Book that can be downloaded from UPENN Library
- Scott Marble, *Digital Workflows in Architecture: Design - Assembly - Industry* (2012, Walter de Gruyter GmbH) E Book Central Book that can be downloaded from UPENN Library

Additional Readings, recommended

- Yasha J. Grobman and Eran Neuman, *Performatism: Form and Performance in Digital Architecture* (2011, Taylor & Francis Group). E Book Central Book that can be downloaded from UPENN Library
- Derek H. T. Walker and Steve Rowlinson, *Routledge Handbook of Integrated Project Delivery* (Routledge, 2019) <https://www.routledgehandbooks-com.proxy.library.upenn.edu/doi/10.1201/9781315185774-29>, Available on-Line
- Arup Materials Master Class Videos [Follow this link for ARUP Materials Masterclass](#)

*This syllabus is dedicated to Prof. Lindsay Falck who taught an inspired version of this course for decades.
He continues to inspire our work today.*

