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A Peer Review Benchmark Portfolio for ARCH 411: Integrate

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Abstract
In North American universities, the comprehensive, or integrative studio, represents an important moment in the curriculum of architecture programs where students are likely to encounter especially challenging design problems due to the integrative thinking required at a number of scales. Providing students with concepts and tools to handle these problems at this stage is therefore crucial to their success in the studio and their development as architects. This research explores the application of dynamic multi-objective optimization (DMOO) concepts and tools within a comprehensive studio context to help students improve their ability to explore tradeoffs between design solutions. DMOO offers a rigorous conceptual framework and provides methods for the comparative analysis of design solutions and their trade-offs. To test this claim, a pedagogical methodology to integrate these concepts and tools is described and then tested through the comparative analysis of student work. The results show that use of DMOO concepts and tools in the early and late stages of design does improve exploration of trade-offs between possible design solutions.

Keywords: Architectural Design; Comprehensive Studio; Built Environment; Project-Based; Computer-Aided Design

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1. Objectives of Peer Review Course Portfolio

The architectural design process involves balancing multiple quantitative and qualitative objectives, understanding the trade-offs between these objectives, and dynamically reprioritizing them when the goals of the project inevitably change. Architectural design problems can therefore be understood as dynamic multi-objective problems (DMOPs). In North American universities, the comprehensive, or integrative studio, represents an important moment in the curriculum of architecture programs where students are likely to encounter especially challenging DMOPs due to the integrative thinking required at a number of scales. Providing students with concepts and tools to handle these problems at this stage is therefore crucial to their success in the studio and their development as architects. But how can educators effectively teach students to manage these problems within a comprehensive studio context? What concepts and tools can students use to efficiently explore the trade-offs possible between multiple objectives within a space of possibility? Dynamic multi-objective optimization (DMOO) is an emerging area of research in the fields of computer science and optimization that offers a rigorous conceptual framework by which to better understand DMOPs. It also provides methods to find optimal design solutions as well as methods for the comparative analysis of those solutions and their trade-offs. This research proposes an approach to integrate DMOO concepts and tools into a comprehensive studio curriculum. Further, it assesses the following two claims through a comparison between two different course sections: 1. In the analysis and schematic design phases, DMOO provides a conceptual framework that improves comparative understanding and exploration of precedent architectural works when tested against action centric approaches; 2. In the latter design stages, DMOO provides a conceptual framework and search methodology that improves exploration of trade-offs possible between objectives.

2. Description of the Course

The final design studio course for the undergraduate architectural curriculum is “Arch 411 Architectural Design Studio: Integrate.” This course is conducted in a studio format in which students work in teams of two to develop and represent a design proposal for a building that integrates multiple technical systems in a seamless manner to address qualitative and quantitative objectives. This studio course has a class size per studio section of between 10-14 students, with four sections taught by four different instructors. The class meets three days a week for four hours each day. The majority of the teaching for the course is done in the form of individual discussions between the instructor and each team as they develop their individual projects for the term.

Relation to the Larger Curriculum

This course represents the culmination of the entire undergraduate architectural curriculum. It is a course that is also responsible for meeting several key requirements for accreditation of the professional MArch degree. As such, the course is required to deal with a number of technical issues with a higher degree of detail and resolution than done previously in the program. To aid in covering some of this technical ground, a companion core seminar course titled “Arch 430 Building Integration” is mandatory for students to take during the same term as Arch 411. The two courses then work together to help students develop their term project for Arch 411.

Challenges

This course serves a key curricular role and also is viewed by students in the program as the pinnacle of their undergraduate architectural education. These pressures can make teaching this course challenging for several reasons. The first challenge involves meeting the accreditation requirements for the course, which involves demonstrating students can deal with several technical issues in building design. Instructors must also provide additional objectives that further enrich student learning by addressing cultural and theoretical issues. Covering the technical objectives alone is a challenge in the short timeframe of a term. To cover all this content, instructors must coordinate with the instructor of the companion seminar (i.e., Arch 430), and this coordination can be time consuming.

Another set of challenges comes from managing student expectations of the course. Students often come into the class on day one expecting to completely resolve the design of an entire building at expert level by the end of the term – something which is not possible. The weight of this misconception both motivates and makes them anxious. It is a challenge to manage this expectation and keep them grounded in what is possible, while keeping them motivated.

Learning Objectives

The course has several required learning objectives that must be fulfilled for accreditation purposes. Students must demonstrate the ability to create building designs that follow relevant codes and regulations. They must demonstrate the ability to create technical documentation (e.g., construction drawings) that clearly and accurately communicates design intent based on accepted standards. They must demonstrate the ability to design technically proficient building envelopes and assemblies. Lastly, they must demonstrate the ability to integrate multiple technical systems (i.e., structural, environmental, life-safety) together in order to address quantitative (e.g., energy efficiency, safety, etc.) and qualitative (e.g., aesthetic, cultural, conceptual, experiential, etc.) goals. This last objective is the most important.

Instructors are also expected to add additional objectives that may deal with culture, theory, history, or technology. In previous versions of the course, I have added objectives that relate to the design of spaces for knowledge creation and collaboration. I have also added objectives that require students to learn about emerging construction and design technologies. These added objectives give a specific context in which to address the objectives related to accreditation and are chosen to relate to my research, while hopefully making the course more interesting for students.

Course Structure

The structure of the course is typically divided into four major parts: analysis and research; schematic design; design development; and synthesis. The first portion of the course is a 2-3 week period of analysis and research. During this period students are given the design problem for the term and begin researching the problem, the given location for the project, and the activities that will need to take place in the project.

After the initial research and analysis phase, students then move into a 6-week period in which they develop initial designs for the building. This schematic design phase is where the major design decisions are made that will inform the rest of the term. It is a phase that is typically the most difficult and students are struggling to develop clear goals for the project and a design approach that can meet those objectives in a persuasive manner.

The next phase is the design development phase which lasts about 3-4 weeks. During this phase each team must begin to develop the technical dimensions of their project in greater detail while refining their overall design. In this phase, the challenge comes in developing the design at multiple scales (e.g., site, building, room, and detail scale) and learning to work with technical requirements that they haven’t had to deal with before.

Lastly, teams move into the synthesis phase. This is where the design needs to demonstrate integration of technical systems at many scales in order to address quantitative and qualitative goals. Integrating these systems so that the teams are able to produce a cohesive and streamlined project is demanding on all levels and culminates with a final review in front of a panel of professionals that evaluate each team’s final design.

3. Teaching Methods and Activities

The course is taught in a studio format in which the majority of class time throughout the term is spent on individual discussions between the instructor and the student teams. During the course of a typical day the instructor visits with each team providing feedback on the individual design projects being developed. During these desk critiques, progress of team design projects is reviewed, and guidance is given on what may need more development and what the next steps to address those issues might be. Instructors often demonstrate through sketching with students on ways to solve particular design issues. Precedent design work is also discussed and used further examples of how to address particular design issues. Progress is determined based on how the teams address feedback through their design projects.

Peer evaluation and feedback is used in the course to allow students to develop as architectural critics and thinkers. Throughout the term, student teams are asked to review each other's work and to provide constructive feedback on that work. This feedback can often help students navigate design problems and also provide students an opportunity to see how each other works and to adopt successful behaviors as they see them.

Group work is an important part of the class and all students work in groups for the duration of the term. This format allows students to build their interpersonal, leadership, and organizational abilities. These skill sets are crucial in professional environments and this course in combination with the design studio preceding this course further helps to build these skills. The achievement of these skills is evaluated by the instructor through careful observation of team dynamics and guidance when teams seem to be underperforming.

Lectures are used in the course once or twice a month in order to communicate technical and theoretical information that supports the courses objectives. Readings and tutorials are also given to support the lectures. Student learning from these methods is assessed through the development of the individual team design projects.

Course Activities

The course is organized around the development of one term long architectural design project that is used to demonstrate student knowledge and skillsets relative to the course objectives. There are a series of design reviews spaced throughout the term in which outside reviewers (e.g., professional architects, engineers, consultants, etc.) are brought in to give feedback to student teams on their projects. These reviews provide theoretical and technical feedback from a spectrum of voices and are used to help students understand the weaknesses of their current design approaches and to understand how those weaknesses might be addressed in future development.

The schedule for the term was separated into five phases: analysis; schematic design; intermediate design; and synthesis. DMOO concepts and tools were then chosen to support these phases. Specifically, in the initial stages of design (i.e., analysis and schematic design phases), students are given a lecture and introduced to key DMOO concepts. The concept of decision variables (i.e., design parameters) and decision space (i.e., space of possible parameter configurations) is first discussed to get students thinking about the relationship between the specification of geometric design parameters and how that choice produces a certain space of possibility for designs. The dynamic nature of decision spaces during a design process is also a key point of emphasis – as architects may start out working with one set of design parameters and add or delete them as the design is developed and new information comes to light.

The concept of quantitative (i.e., mathematically measurable goals) and qualitative (i.e., aesthetic goals) objectives is then discussed along with how these two different types of goals might be evaluated. The discussion provides the opportunity for students to reflect on the ways they have measured the performance of their designs in both quantitative and qualitative ways in past studios and stimulates them to think of new methods for evaluation. The role of such metrics is also discussed from a rhetorical point of view - in terms of how the visualization of these metrics can be used to make an architectural design position more convincing.

Students then learn that the objectives of a project define a space of performance possibility for a design (i.e., objective space). Further, they learn that in multi-objective problems there is usually not just one solution to a problem but several different possible solutions representing different trade-offs between objectives (Coello, Van Veldhuizen, and Lamont 2002). The last point of emphasis is that objectives can and do change during a design process due to changing priorities, constraints, and new information on what goals are actually attainable.

In the analysis phase, students are then asked to apply these concepts to the analysis of a set of precedent architectural projects. In the exercise, students first identify the most important objectives related to the design project for the term. They then use these selected objectives to construct a space of possible design solutions (i.e., an objective space) for the analysis. This objective space is then graphically represented, and each precedent is mapped to this space of possibility. This mapping operation visually reveals how each project relates to one another and also reveals areas in the objective space that seem to be over-explored and under-explored by the precedents.

In the schematic design phase, students are then asked to use this map in a generative fashion to create new organizational ideas for their term project. Based on an exercise developed by Tom Hartman at the Design School at Arizona State University, students are then asked to generate new parti ideas through two generative operations: extrapolation (i.e., generating ideas at the extremes of the objective space) and interpolation (i.e., generating ideas by interpolating between existing projects in the objective space). Both of these generative operations are shown in the right side of Figure 1 and are used by each team to develop an organizational approach to the term project. This generative map helps to bridge the gap between analysis and design ideation. Further, the introduction of these concepts helps to stimulate meta-cognitive thinking – as students realize that the definition of an objective space for a project can be generative of new knowledge, and as that definition changes, so does the knowledge created.

In the latter stages of the term (i.e., intermediate, design development, and synthesis stages), student teams are introduced to methods and digital tools for decision space definition and exploration (e.g., parametric modeling); evaluation of objectives (e.g., daylighting, structural, and aesthetic performance analysis); and exploration of objective spaces (e.g., computational optimization). The concepts defined during the analysis and schematic phases are also used by the students in these latter phases to think meta-cognitively about the given design problem and the methods they might use to search a space of possibility and comparatively evaluate design solutions.

Rationale

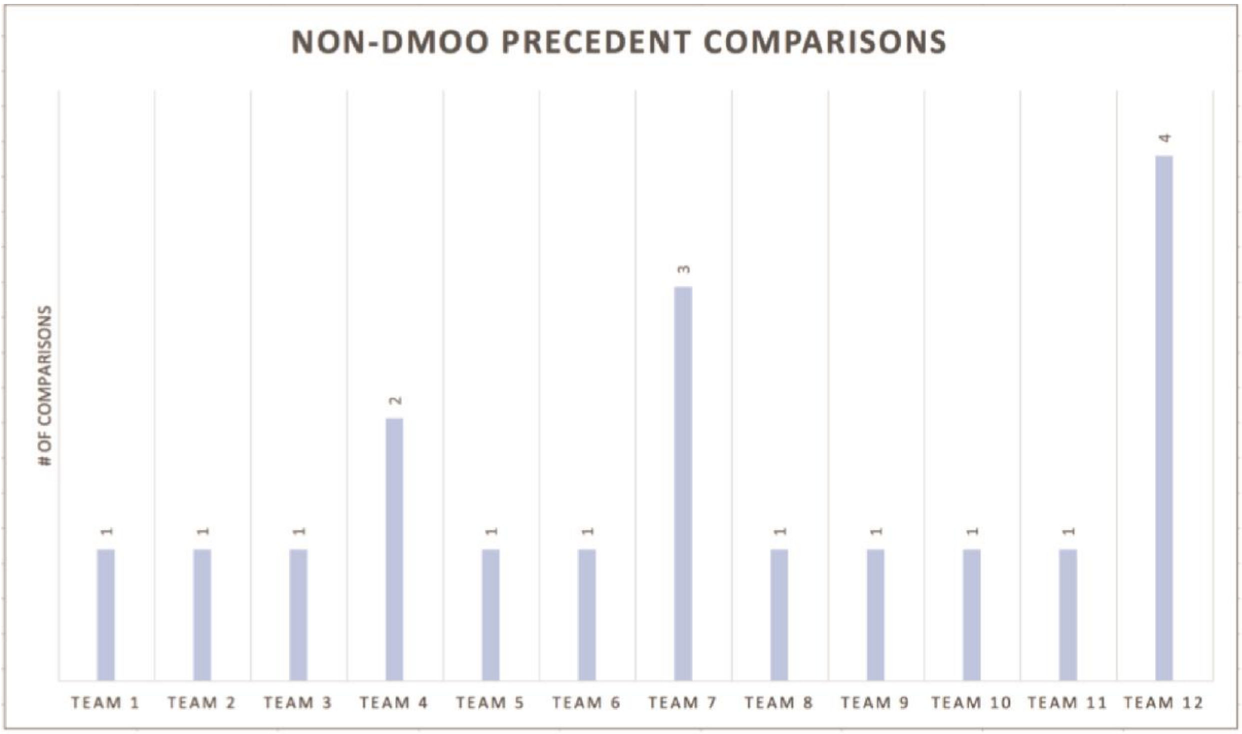
The course is based around the development of one design project mainly due to time constraints and the requirements of accreditation. The team-based format allows students to develop key collaboration and interpersonal skills, while also allowing students to produce design projects that have a much higher level of resolution. Both of these choices also build on previous courses in which collaboration and design complexity increase in intensity as students move through the program.

The use of one-on-one critiques between instructor and student teams allows for students to learn the course objectives through application under the guidance of the instructor. The use of reviews with outside critics further inject professional knowledge into each student's experience and help the realization of course objectives. These methods also allow the work to be constantly evaluated both quantitatively and qualitatively and from a variety of voices in the process.

4. Analysis of Student Learning

This research began with the following two hypotheses: 1. In the analysis and schematic design phases, DMOO provides a conceptual framework that improves comparative understanding and exploration of precedents when tested against action centric approaches; 2. In the latter design stages, DMOO provides a conceptual framework and search methodology that improves exploration of trade-offs possible between objectives. In order to assess the validity of these claims, the student work of a comprehensive studio using the methodology described above is compared with the work produced by another section not using the stated methodology.

In order to assess the validity of the first hypothesis, the work from each studio was analyzed for evidence of comparative thinking and design exploration. This was done by looking through the final work of both studios for the analysis and schematic phases of the term and tallying instances where comparisons between two or more precedent projects was evidenced through diagrams, text, or drawings. The results of this analysis can be seen in Figure 1. These results show that on average there was evidence of around 43 instances of comparative thinking per team for the DMOO-based studio. In contrast, the other studio averaged only 1.5 comparisons per team. Students in this group were encouraged to think comparatively but were left to develop their own methods of comparison. This resulted most often in a comparison with only one other project.



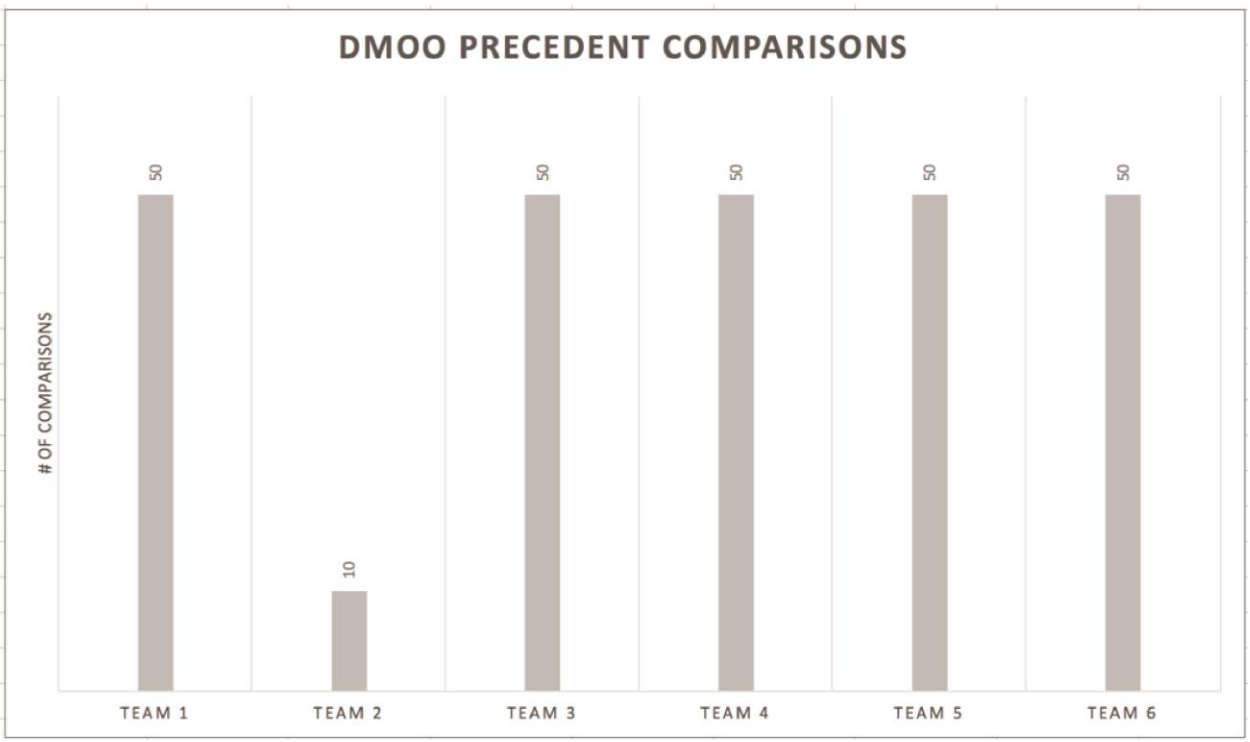


Figure 1 (Top) Shows the assessment results from the analytic and schematic phases of the term for the comprehensive studio not using DMOO concepts or tools. (Bottom) Shows the results for the DMOO-based studio.

To assess the validity of the second hypothesis, the midterm and final work of both studios was examined for evidence of the exploration of trade-offs between project objectives. Specifically, instances where drawings, renderings, or diagrams were used to show a comparison between two or more design solutions was tallied. The results for this analysis can be seen in Figure 2. The data shows that the DMOO-based studio outperformed its competitor by more than double during the midterm and by seven times in the final review.

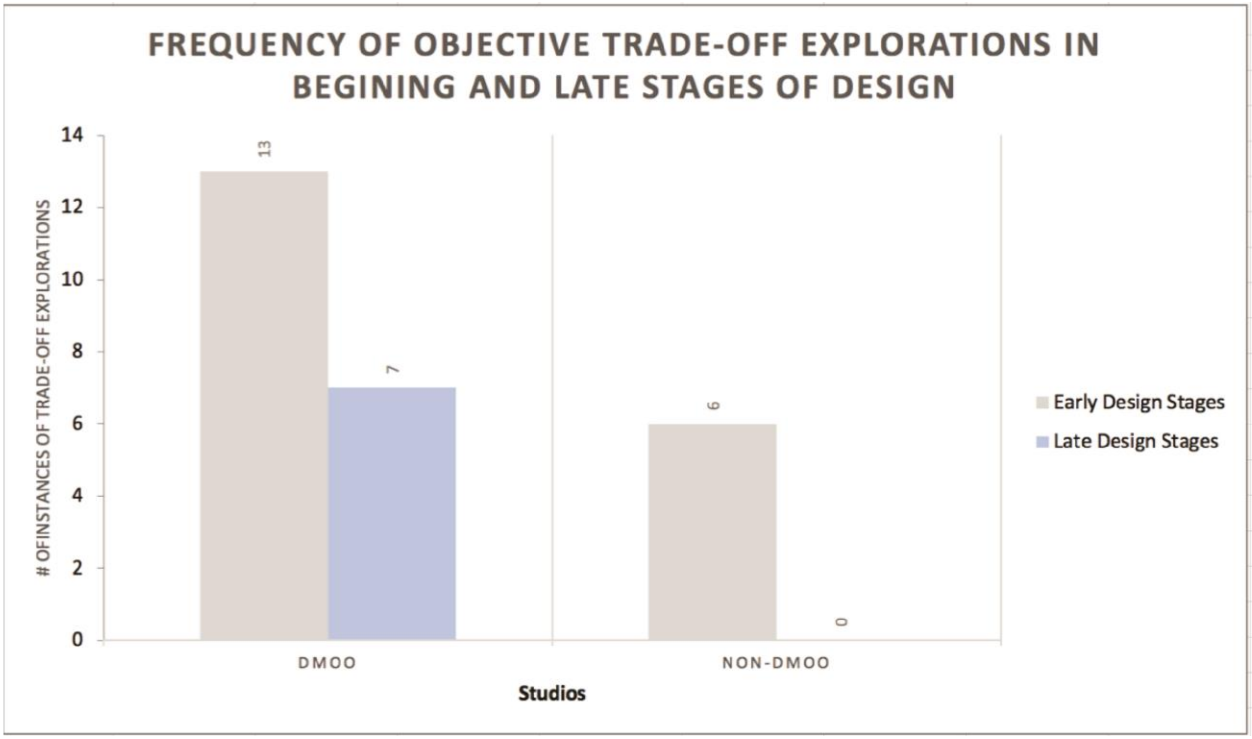


Figure 2 Shows the analysis results for the intermediate and synthesis stages of design.

5. Reflection on the Course

The aim of this research was to explore the effectiveness of integrating concepts and tools from the field of dynamic multi-objective optimization to help educators effectively teach students to manage dynamic multi-objective problems within a comprehensive studio context. These techniques were assessed for their ability to promote comparative thinking and the exploration of trade-offs between design solutions. A comparative study between two comprehensive studios - one using DMOO concepts and tools and the other not using them – revealed that the DMOO-based approach aided in comparative thinking and exploration of tradeoffs throughout the beginning and latter phases of the term.

Future work will need to verify these results by conducting further studies on more studio sections and also develop improved metrics to measure the effectiveness of DMOO integration. This work will also need to evaluate whether DMOO concepts, DMOO tools, or both simultaneously applied in a studio context, has the most impact on positive learning outcomes. Developing faster and more user friendly DMOO tools is also a pressing problem for future investigation.

The development of concepts and methods that can help students effectively balance multiple objectives in the architectural design process is a pressing need as the profession is asked to engage problems of greater and greater complexity in response to environmental, social, and economic crisis. This research represents a step in this direction, but as noted, there are many challenges ahead, and much work still to be done to prepare students with the tools they will need to tackle these wicked problems.

Appendix A – Course Syllabus

Digital Tectonics: Fabricating Innovation Spaces

Arch 411 Architectural Design Studio: Integrate (5 credits)

| MWF 1-4:50 PM | Studio Location: Architecture Hall West 18A

00 Instructor

David Newton | david.newton@unl.edu | Office: 246 Arch Hall West | office hours by appointment

01 Catalog Description

Continuation of complex problems as it relates to the integration and consideration of environmental stewardship. Emphasizing technological considerations as formal and organizational influences including technical documentation, accessibility, site design, life safety, environmental systems, structural systems, and building envelope systems and assemblies.

02 Prerequisites

Arch 410, or by permission.

03 Studio Description

The transition in many first world economies from an industrial economy to information-based economies over the last 30 years has meant a sea-change in the type of jobs available and the types of architectural spaces needed in order to accommodate the demands of innovation and knowledge creation. The demand for spaces that can foster innovation, knowledge creation, and collaboration has led to the development of a new building typology in the last decades. The terms “creative clusters” and “innovation hubs” have surfaced to describe this new typology, and over the last two decades there has been an impressive upsurge in their design and construction all over the world. Projects such as the Stata Center at MIT and the Perimeter Institute for Theoretical Physics Phase I & II in Waterloo can be considered early prototypes of such spaces. In the design of such innovation spaces several key questions for architects emerge and will be the focus of the studio: How can architecture be designed to foster innovation, collaboration, and learning? What does such and architecture look like and how is it different than traditional labs or schools? How should private research spaces (labs, etc..) be connected with more public functions? What is the role of social spaces in such projects? What is the role of technology in such spaces?

The information-based economy has also led to a revolution in design, construction, and responsive building technologies. These technologies offer profound possibilities for the design of performative and expressive architecture. Architects such as Charles and Ray Eames, Jean Prouve, and Walter Gropius created innovative designs and design practices through the exploration of the emerging fabrication technologies of their time. In this information era, how should we build? How can we be innovative? How can we use technology to build meaningfully? This studio will engage these emerging technologies and explore these questions within the context of the design of spaces for knowledge creation. Specifically, the studio will design an Innovation Center for Emerging Fabrication Technologies.

04 Course Outcomes

For completion of the course students are expected to have acquired and will be evaluated on:
Ability to engage multiple formative and organizational parameters of a project from conception through resolution.
Demonstrate the ability to navigate multiple solutions ultimately demonstrating comprehensive design.

Develop knowledge and technical skills on the use of digital design and digital fabrication processes in the design of building systems.

05 Assessment

Students are required to submit:

Deliverables listed in Phase 1: Research and Analysis
Deliverables listed in Phase 2: Schematic Design
Deliverables listed in Phase 3: Design Development
Final Documentation

06 NAAB Criterion

The National Architectural Accrediting Board identifies (34) performance criteria it determines to "constitute the minimum requirements for meeting the demands of an internship leading to registration for practice." Information describing the 2009 National Architectural Accrediting Board (NAAB) Conditions and Procedures for accreditation can be found by going to that organizations web site www.naab.org.

B3: Codes and Regulations
B4: Technical Documentation
B7: Building Envelope Systems
B8: Building Materials and Assemblies
C3: Integrative Design

07 Course Format

All studios will abide by the College of Architecture studio culture document. This document can be downloaded from the Resources tab on the College of Architecture website. The studio will maintain a professional atmosphere in the studio at all times. This not only refers to the attitude and seriousness of each of us in the studio, but also to the physical environment. Students are highly encouraged to work in the studio in addition to the regular course hours, rather than at home. Students are permitted to work in studio at all hours but sleeping overnight in studio is not allowed.

08 Course Requirements

All students in studio should have the computer programs required by the Architecture or Landscape Architecture department's required software.

09 Feedback, Evaluation, and Grading

Grading breakdown

Grading will be based on completion of all assignments and projects listed below. Projects will be graded with regards to performance and ability to demonstrate grasp of subject matter, breadth and depth of investigation.

Activity	% of final grade
Phase 1: Research and Analysis	10%
Phase 2: Schematic	30%
Phase 3: Design Development	55%
Final Documentation	5%
Total	100%

Semester letter grades will be determined by the following numerical scale:

A+: 100-96.67	A: 96.66-93.34	A-: 93.33-90
B+: 89.99-86.67	B: 86.66-83.34	B-: 83.33-80
C+: 79.99-76.67	C: 76.66-73.34	C-: 73.33-70
D+: 69.99-66.67	D: 66.66-63.34	D-: 63.33-60
F: 59.99 or below		

13 Bibliography:

<u>Required Readings</u>
The recommended readings for the course may be downloaded from the Canvas website platform.

<u>Recommended Texts</u>
While there are no required textbooks for the course, the books listed below are recommended – especially the texts marked with a " * ".

Construction:
Ching, Francis D. K*.* *Building Construction Illustrated*. Hoboken, N.J: John Wiley & Sons, 2008. Print.
Ching, Francis D. K, Barry Onouye, and Douglas Zuberbuhler. *Building Structures Illustrated.* Hoboken, N.J: John Wiley & Sons, 2009. Print.
Deplazes, Andrea, ed. *Constructing Architecture: Materials, Processes, Structures. 2nd Ed*. Basel: Birkhauser, 2012. Print.
Watts, Andrew. *Modern Construction Handbook 2nd Edition*. New York: Springer, 2013. Print.

Materials:
Brownell, Blaine E. Transmaterial: A Catalog of Materials That Redefine Our Physical Environment. New York: Princeton Architectural Press, 2006. Internet resource.
Herzog Thomas. *Timber Construction Manual*. Basel: Birkhauser, 2004. Print.
Kind-Barkauskas, Friedbert, Bruno Kauhsen, Stefan Polonyi, and Jorg Brandt. *Concrete Construction Manual*. Basel: Birkhauser Verlag AG, 2002. Print.
Sobeck, Werner, Christian Schittich, Gerald Staib, Dieter Balkow, and Matthias Schuler. *Glass Construction Manual*. Basel: Birkhauser Verlag AG, 1999. Print.
Sobek, Werner, Helmut C. Schulitz, and Karl Habermann. *Steel Construction Manual*. Basel: Birkhauser Verlag AG, 2000. Print.
Zilch, Konrad, Joachim Achtziger, Gunter Pfeifer, and Rolf Ramcke. *Masonry Construction Manual*. Basel: Birkhauser Verlag AG, 2001. Print.

Codes, Regulations, and Practice Reference:
Allen, Edward, and Joseph Iano. *The Architect's Studio Companion: Rules of Thumb for Preliminary Design*. John Wiley & Sons, 2017. Print.
Ching, Francis DK, and Steven R. Winkel. *Building codes illustrated: A guide to understanding the 2012 International Building Code*. Vol. 6. John Wiley & Sons, 2012.
IBC, ICC. "International building code." *International Code Council, Inc.(formerly BOCA, ICBO and SBCCI)* 4051 (2006): 60478-5795.

Building Systems:
Grondzik, Walter T., and Alison G. Kwok. *Mechanical and electrical equipment for buildings*. John Wiley & Sons, 2014

Architectural Construction Documents:
Hedges, Keith E. *Architectural graphic standards*. John Wiley & Sons, 2017.
Wakita, Osamu A., and Richard M. Linde. *The professional practice of architectural working drawings*. John Wiley & Sons, 2003.

CAD/CAM Processes:
* Hauschild, Moritz and Karzel, Rudiger. *Detail Practice: Digital Processes*. Basel: Birkhauser, 2011. Print.
* Marble, Scott. *Digital Workflows in Architecture: Designing Design -- Designing Assembly -- Designing Industry*. Basel: Birkhäuser, 2012. Print.
McGee, Wes, de L. M. Ponce, and Aaron Willette. *Robotic Fabrication in Architecture, Art and Design 2014*. , 2014. Internet resource.
* Gramazio, Fabio, et al. *Made by Robots : Challenging Architecture At a Larger Scale*. AD Magazine May/June, 2014. Print.

* Menges, Achim. *Material Computation : Higher Integration In Morphogenetic Design*. Chichester: John Wiley, 2012.
Oxman, Robert.*The New Structuralism: Design, Engineering and Architectural Technologies*. AD Magazine September 14, 2010. Print.
Schropfer, Thomas, ed. *Material Design: Informing Architecture Materiality*. Basel: Birkhauser, 2011. Print.
Envelopes:
* Herzog, Thomas, Roland Krippner, and Werner Lang. *Facade construction manual*. Walter de Gruyter, 2004.
Knaack, Ulrich, Tillman Klien, Marcel Bilow, and Thomas Auer. *Facades: Principles of Construction*. Basel: Birkhauser Verlag AG, 2007. Print.
Schittich, Christian and Wiegelmann, Andrea, eds. *In Detail: Building Skins*. 2nd Ed. Basel: Birkhauser, 2006. Print.
* Watts, Andrew. *Modern Construction Envelopes 2nd Edition*. New York: Springer, 2013. Print.

Responsive Systems:
Schodek, Daniel, and Michelle Addington. *Smart Materials and Technologies: For the Architecture and Design Professions*. Burlington: Elsevier, 2005. Print.
Sheil, Bob. *Proto Architecture: Analogue and Digital Hybrids.* AD Magazine July 14, 2008. Print.

14 Schedule (subject to change)

Week	**1**		**Assigned**
M	1.8	Intro to Studio	Research and Analysis
W	1.10	Desk Crits	
F	1.12	Desk Crits	
Week	**2**		
M	1.15	No Class - MLK Holiday	
W	1.17	**Pin-up Research and Analysis Phase 1.1**	
F	1.19	Desk Crits	
Week	**3**		
M	1.22	**Pin-up: Research and Analysis Phase 1.2**	Schematic Design
W	1.24	Desk Crits	
F	1.26	Desk Crits	
Week	**4**		
M	1.29	In class pin-up	
W	1.31	Desk Crits	
F	2.2	Desk Crits	
Week	**5**		
M	2.5	**Review I Schematic Design**	
W	2.7	Desk Crits	
F	2.9	Desk Crits	
Week	**6**		
M	2.12	In class pin-up	
W	2.14	SGH presentation 1-2pm / Desk Crits	
F	2.16	Desk Crits	
Week	**7**		
M	2.19	In class pin-up	
W	2.21	Desk Crits	
F	2.23	Desk Crits	
Week	**8**		
M	2.26	**Review II Schematic Design /** Studio walk-around	Design Development
W	2.28	Dri-Design presentation 1-2pm	
F	3.2	Desk Crits	
Week	**9**		
M	3.5	In class pin-up	

W	3.7	Desk Crits
F	3.9	Desk Crits
Week	**10**	
M	3.12	In class pin-up
W	3.14	Desk Crits
F	3.16	**Technical Review I**
Week	**11**	
M	3.19	No Class - Spring Break
W	3.21	No Class - Spring Break
F	3.23	No Class - Spring Break
Week	**12**	
M	3.26	In class pin-up
W	3.28	Desk Crits / *Registration Deadline Steel competition*
F	3.30	Desk Crits
Week	**13**	
M	4.2	In class pin-up
W	4.4	Studio-wide walk around / Desk Crits
F	4.6	Desk Crits
Week	**14**	
M	4.9	**Technical Review II**
W	4.11	Desk Crits
F	4.13	Desk Crits
Week	**15**	
M	4.16	In class pin-up
W	4.18	Desk Crits
F	4.20	Desk Crits
Week	**16**	
M	4.23	In class pin-up / final drawing review / practice presentations
W	4.25	**Final Reviews**
F	4.27	**Final Reviews (Last Class)**
Week	**17**	
M	4.30	Final documentation due by 5pm