Expanding Strategies towards Architectural Design and Building Technology Integration

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Abstract

Our architecture program mission statement establishes that we “value design excellence centered in the poetic merging of the arts and technology”. This objective frames current curriculum and pedagogical strategies being implemented which aim to integrate the building technology sequence with architectural design studios at key moments in our undergraduate and graduate programs. Described as a “multifaceted integration model” in a recent publication by the author, a summary of strategies focused on our undergraduate Bachelor of Science in Architecture degree program was presented. These included introducing design thinking in materials and methods and the structural systems one-year sequence, integrating structures and building assemblies in design studios, industry partnerships to enhance courses, and research initiatives at the program and college levels.

This paper takes a more in depth look at the specific initiatives developed to expand curriculum and pedagogical strategies aiming towards better integrating and coordinating the Integrative Design Studio and the Technical Integration Seminar in the first semester of our NAAB-accredited Master of Architecture degree program. Both courses are taught during the same semester at each of our campus locations. Changes in faculty teaching the courses have provided a varied set of approaches and resources introduced to recent generations of students. Challenges and opportunities of delivering the two courses and their relationships as co-requisites are discussed. Collaborations among faculty teaching these courses in each location (or both through distance learning) have explored focused areas as themes for the design projects such as mass timber structures and assemblies, or lighting and green design strategies.

This paper describes the integration strategies implemented in our curriculum and pedagogical approaches, collaboration models between faculty, initiatives engaging industry and academic research partnerships to strengthen theme-based directions in our courses and program (e.g. wood), and ongoing discussions on learning outcomes and evaluation criteria at this level.

Keywords: Pedagogy, Curriculum, Assessment, Integrated Architectural Design, Technical Integration

Introduction

Curriculum and pedagogical strategies are being implemented in two courses in our NAAB-accredited Master of Architecture (M.Arch) degree[1] program at University of Idaho: Arch553-Integrated Architectural Design and Arch568-Technical Integration in Design. These strategies aim towards bridging the gap between architectural design and building technology courses at the graduate level. Strategies implemented in our undergraduate program were discussed in a recent publication (Armpriest & Manrique, 2017)[2].

Our Architecture Program offers three M.Arch degree tracks. A seamless BS.Arch Bachelor of Science (4-years) and Master of Architecture (2-years); a 2+ M.Arch

(summer studio plus 2-years) for BS. Arch or BA. Arch Degree holders; and a 3+ M.Arch (summer plus 3-years) for BS or BA Degree holders. Arch553-Integrated Architectural Design and Arch568-Technical Integration in Design are offered as co-requisites in the first semester (fall) of the academic year in the first, second and third years of each program (table-1).

Table 1 Arch553 and Arch568 in M.Arch degree tracks (fall)

B.S. + M.Arch	Seamless	G-1 year
2+ M.Arch	BS. Arch or BA. Arch Degree holders	G-2 year
3+ M.Arch	BS or BA Degree holders	G-3 year

In addition to efforts for bridging the gap between architectural design and building technology courses, on-going discussions addressing assessment requirements at the university level are being used to identify (measurable) student learning outcomes.

In our current draft (February, 2019), "Design Integration Skills" has been identified as a learning outcome in our M.Arch program where students will demonstrate "effective design synthesis skill, including the integration of material, structural, environmental control, and other building systems"[3]. This learning outcome has been identified as to be measured in both our Arch553-Integrated Architectural Design and Arch568-Technical Integration in Design courses. Specific methods for measuring this learning outcome are also being discussed. The development of a Studio Evaluation Form is being proposed for Integrated Architectural Design and course evaluations/grading for measurements in Technical Integration in Design.

As a recent faculty in the architecture program at University of Idaho (joined in fall 2015) I have been interested in recognizing the variety of methods used by faculty and the opportunities for collaboration (internal and external). This exercise constitutes an internal (and personal[4]) critique and assessment of ongoing efforts towards architectural design and building technology integration in our graduate program. This first stage towards developing an integration framework in our graduate program aimed to document these efforts (otherwise lost due to faculty turnover), and identify and discuss key lessons suggested.

Expanding strategies towards architectural design and building technology integration

The strategies toward architectural design and building technology integration discussed in this paper are used to document pedagogical approaches explored by individual faculty and some collaborations which have been developed through common interests in spontaneous ways. Strategies are organized by addressing two goals:

The first goal, "strengthening theme-based design studios", aims towards developing topics that enhance our presence as architects addressing key aspects in our community and region. For example, a key theme refers to the re-emergence of the use of timber and manufactured wood structural products in recent years.

The second goal, "reinforcing design thinking", aims towards developing approaches that contribute to "activate the disciplinary power of architecture" which requires going beyond the "tendency of looking to science to substantiate design and design research" (Teal, 2018)[5]. This goal is targeted to prepare students in their first year of our NAAB-accredited Master of Architecture degree program for more advanced work developed through the Graduate Project Seminar.

Table 2 Summary of Integration Strategies in the Master of Architecture (Integrated Architectural Design and Technical Integration)

Goals	Strategies	Tactics
1-Strengthening Theme-based design studios	a) Developing and expanding internal collaborations	Full integrations
		Collaborative integrations
		Explorative integrations
	b) Developing and expanding external collaborations	Expanding presence of current partnerships
		Expanding connections with Industry to enhance field trips
		Expanding sponsorships through existing partnerships
		Expanding network through existing partnerships
2-Reinforcing Design Thinking	a) Expanding references	Exploring connections to the 'poetic' nature of tectonics
	b) Calibrating precedent studies	Integrating through precedent studies
		Enhancing field trips
	c) Introducing design thinking to building technology courses	Using a design challenge approach in Technical Integration

1. Strengthening theme-based design studios

Wood and light are selected as two themes that have been used recently by faculty in our Integrated Architectural Design studios and relate to priorities in our program. These themes have triggered opportunities for developing and expanding internal and external collaborations requiring to revise course objectives and learning outcomes, and refine exercises and experiences (e.g. field trips).

a) Developing and expanding internal collaborations:

The Internal collaborations discussed below (full, collaborative and explorative) refer to opportunities between faculty and resources in the architecture program, and other programs at University of Idaho.

An example of a full integration between Integrated Architectural Design and Technical Integration in Design was developed when one faculty was in charge of both courses. In fall 2012, the Integrated Architectural Design studio was sponsored by the Idaho Forest Products Commission (IFPC) to develop a design competition exploring “design opportunities using Idaho wood species (solid wood or manufactured wood products)” (Armpriest, 2012)[6].

In addition to the seamless integration between both courses and the development of the partnership with IFPC (which would extend until today through a design competition in our third year undergraduate studio), the competition worked with the College of Natural Resources to define the topic of the design challenge: The Pitkin Nursery Learning Center, a building for their forest nursery and seedling research facility. In 2013 this project was designed and constructed by Patano Studio winning AIA and National Green Building awards in 2014 and 2015 respectively (Patano Studio Architecture, 2017)[7]. The model used for this competition was translated to the undergraduate level from a full semester to a half of a semester duration (8-weeks).

The full integration model provided a convenient way of guaranteeing co-requisites working well together. At some point it was discussed in our program creating a full 9-credit course merging Integrated Architectural Design and Technical Integration to oblige this model for future semester programming. One challenge identified to implement this approach was that it would reduce the flexibility in the distribution of courses

among faculty. In our program flexibility is a key aspect. Every faculty is able to teach design studio at both graduate and undergraduate levels, in addition to lecture-based courses in their area of expertise. Furthermore, increasing flexibility needs are being required to cover the delivery of courses in both campus locations (Moscow and Boise, Idaho).

An example of a collaborative integration between Integrated Architectural Design and Technical Integration was developed in fall 2018 when both faculty in charge of these courses decided to agree on discussing and sharing points of convergence during the semester.

Integration between a structures faculty (Manrique, 2018)[8] and a construction and building assemblies faculty (Armpriest, 2018)[9] who had previously worked collaboratively in the third year undergraduate Architectural Design studio developing two competitions sponsored by the Idaho Concrete Masonry Association (ICMA) and the Idaho Forests Products Commission (IFPC). This previous experience of working together, which started in fall 2015, allowed for an easier communication and agreement in key coordination aspects such as cross-themed selection of case studies in Technical Integration focusing on wood as a theme to be developed in Integrated Architectural Design, and final submission requirements being complementary (e.g. wall section model developed from the final project). Challenges in this model were mostly related to registration issues such as students not taking both courses at the same time (courses are defined as co-requisites but not enforced). This generated clear differences in the Integrated Design Project outcomes making visible gaps in building technology topics provided in the Technical Integration course.

Some efforts towards implementing this collaborative integration model were explored in fall 2018 between two faculty teaching the Integrate Architectural Design course in both or Moscow and Boise locations, and faculty teaching Technical Integration from Boise for both campuses (online to Moscow). Most of the conversations focused on sharing general information (e.g. syllabus, general schedule and first project descriptions) in order to coordinate general topics between co-requisites. Despite the interest in sharing information between faculty, the distance between campus locations did not promote a natural opportunity for further discussions during the semester. However, through sharing exercise briefs and following up with students taking both courses key information was gathered.

An example of an explorative integration refers to opportunities initiated by faculty teaching Integrated Architectural Design in our Boise campus using “light” as a theme. This theme, defined in the class syllabus for fall 2018 as “an art for mapping and detailing light” (Montoto, 2018)[10] encouraged students to use resources and design tools from our Integrated Design Lab (IDL)[11]. This opportunity was enabled by having the IDL Director at the time teaching the Technical Integration course for both Boise and Moscow campus locations (Cooper, 2018)[12].

Challenges related to these integration model are tied to facilities not being close enough to stimulate the use of resources. For the students in Boise, the IDL is located in a different building. The building is not far away but only students directly involved in projects (e.g. as research or teaching assistants) access the facility regularly. For the students in our campus in Moscow (295 miles away), the connection with IDL is mostly as an online reference. Opportunities to encourage this integration model are currently being discussed. For example, increasing the teaching role

of the IDL Director will contribute for students in the Boise campus to perceive the resources in this facility as available and approachable. As delivery of distance courses from Boise to Moscow increase and improve, the use of online resources and communication will encourage a more seamless approach. Faculty teaching environmental systems in our main campus location have also explored "light" as a theme and use the Daylighted Artificial Sky project, built in our architecture building, as a resource for design studios and building technology courses (Haglund, 2019)[13].

b) Developing and expanding external collaborations:

External collaborations refer to opportunities to develop new and expand existing partnerships between our programs at University of Idaho and Industry.

Expanding current partnerships: Student work examples when our Idaho Forests Products Commission (IFPC) competition was held in our Integrated Architectural Design graduate course (Armpriest, 2012) suggest evaluating if this is a better level for this experience. This competition was moved to our second-half of the semester in our third-year undergraduate program. Expanding the collaboration would suggest proposing to develop a second competition in order to expand wood as a theme in both our undergraduate and graduate programs. A possible collaboration with the competition held at the graduate level can be discussed with our structural engineering program which started to offer a "Timber Design" course in fall 2018 and developed, for the first time the same semester, a "Best of Idaho Wood" Engineering Design Awards competition (IFPC, 2018)[14].

Other opportunities include expanding connections with Industry to enhance theme-based field trips. In spring 2018 the Integrated Architectural Design studio explored wood as a theme (Manrique, 2018) and developed a visit to exemplar wood buildings (e.g. Kengo Kuma & Hatcher, Portland Japanese Garden) and architectural firms at the forefront of development in the use of this material (e.g. Lever Architecture at Albina Yard). Expanding sponsorship through existing partnerships can reinforce theme-based studio approaches (e.g. funding field trips for students), and research work to enhance courses (e.g. research assistant sponsorships). Other possibilities include expanding our network through existing partnerships (e.g. Woodworks through our IFPC contacts).

2. Reinforcing design thinking

Three strategies aiming to reinforce design thinking are discussed: expanding references, calibrating precedent studies, and introducing design thinking to building technology courses.

a) Expanding references:

Typical references used in our design studios aim towards bridging the gap between architectural design and building technology (e.g. Allen's Studio Companion, Ching's Building Construction and Structures Illustrated, etc.) which are known by students who are coming to our graduate program from an undergraduate program in the United States. Some of these references are not known by students coming to our master program from abroad so our Integrated Architectural Design and Technical Integration courses have the role to introduce these references. References used in Technical Integration (Cooper, 2018) include "Architectural Detailing" (Allen & Rand, 2016)[15], "Integrated Buildings: The System Basis of Architecture (Bachman, 2003)[16] and "Integrated Design in Contemporary Architecture (Moe, 2008)[17]. In addition to these resources, "The Architectural Detail" (Ford, 2011), was a reference used in the two

Integrated Architectural Design sections, in both Boise and Moscow locations, and in Technical Integration. This reference was required as an effort to stimulate more advanced understandings of the role of details and tectonic expression in the design process. References such as “Model Perspectives: Structure, Architecture and Culture” (Cruvellier et al., 2017)[18] and “Introducing Architectural Tectonics: Exploring the Intersection of Design and Construction” (Schwartz, 2017)[19] are currently being considered to explore further connections to the 'poetic' nature of tectonics.

b) Calibrating precedent studies:

Both Integrated Architectural Design and Technical Integration use precedent studies as key exercises. The example in figure-1 illustrates connections explored in Project-1 “Study on the Architectural Detail” (first image in figure-1) and structural model and rendering of an interior view for the final project (second and third image in first row of figure-1). This exercise was developed in previous editions of the Integrated Architectural Design and was shared as part of the collaborative integration effort described previously so it was used as the starting project in both our Boise and Moscow locations (fall 2018).

The exploration through this first project in our Boise campus focused on examining “the detail material systems of a prominent building; identifying its design vocabulary based on how it maps light through architectural detailing” (Montoto, 2018)[20]. In our Moscow location the purpose was using a “well-known building precedent, where wood is the main material used for the structural system, in order to study the way in which design goals were achieved through the development of construction systems integration and detailing” (Manrique, 2018)[21]. Detail design drawings and models (1/2”=1’-0” scale) were required to demonstrate an understanding of designed goals and observed architectonics of the precedent used. “The Architectural Detail” (Ford, 2011) was a required reference in this process.

Initiating the Integrated Architectural Design course with this first project provided a solid starting point for students. One aspect referred to acknowledging the level of detail that would be required for the final project. From simply recognizing the various information to be developed at each scale to establishing an understanding of the rationale their projects should demonstrate. Another aspect referred to getting familiar with the theme of the project (e.g. light or wood) through rigorous research and observation. As an assessment tool, the exercise also provided keys to understand the variety of knowledge students arrive to the course from their diverse undergraduate backgrounds (e.g. design communication skills, building technology).

c) Design thinking to building technology courses:

A design challenge approach was used in Technical Integration in fall 2018 (Cooper, 2018). The examples shown in figure-2, student work for “Research Assignment Five”, required a composite drawing using design from the concurrent (or previous)
Integrated Architectural Design project demonstrating the integration of several systems (e.g. envelope, structure, etc.) through various simultaneous points of view (e.g. plans, sections, perspectives, etc.).

This approach would require further coordination between both co-requisite courses due to the risk of student work being used twice (especially if both courses are in different locations). However, in the last experience (fall 2018) most of the work showed to be complementary for students enrolled in both courses, and contributed to advance in their final projects.

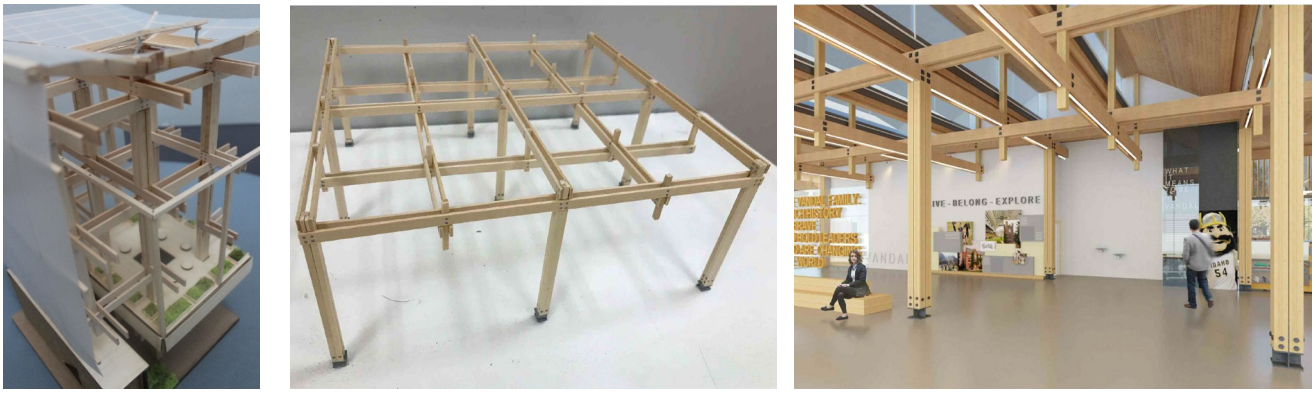

Fig.1 Examples of student work (Swager, D.) Project-1 (1), final project (2, 3) in Integrated Architectural Design (Manrique, 2018).

Fig. 2 Examples of student work (1-Belnap, R. and 2-He, S.) from Technical Integration for Assignment-5 (Cooper, 2018) based on work developed for Integrated Architectural Design from Montoto (2017) and Manrique (2018).

Conclusion

This paper summarizes some of the strategies implemented and identified towards Architectural Design and Building Technology Integration in the first year of our Master of Architecture professional degree. Some to these strategies and the possible ways in which they have an effect in our students can be traced in explorations done during the last year of our Master of Architecture program. An example is illustrated in the student work below (figure-3).

Relationships between architectural technology and design process where explored through an architectural detail precedent study and the development of a main project in Integrated Architectural Design in fall 2017. Means of exploration such as the use of physical models used in this course were taken further in the process of defining a thesis project in the Graduate Project Seminar in fall 2018. The topic started by proposing a study into the effects and possibilities of architecture that defies “tectonic expectations” (Belnap, 2018)[22].

Physical models (and the angles in which they are documented through photographs) are used for exploring ways to express the use of materials that seem in opposition to basic understandings, and for studying precedents that suggest “deceptive methods” to achieve a design goal. For example, the physical model developed for the Sainsbury Center for Visual

Arts (Norman Foster), and the photograph showing only part of the frame, is used to study the deceiving role of "the detailing strategy" of vertical glass mullions reading as non-structural (Ford, 2011:70)[23]. Ford's "The Architectural Detail", introduced in Integrated Architectural Design as a required reference, became the main source for initial understandings and selection of precedents for further studies.

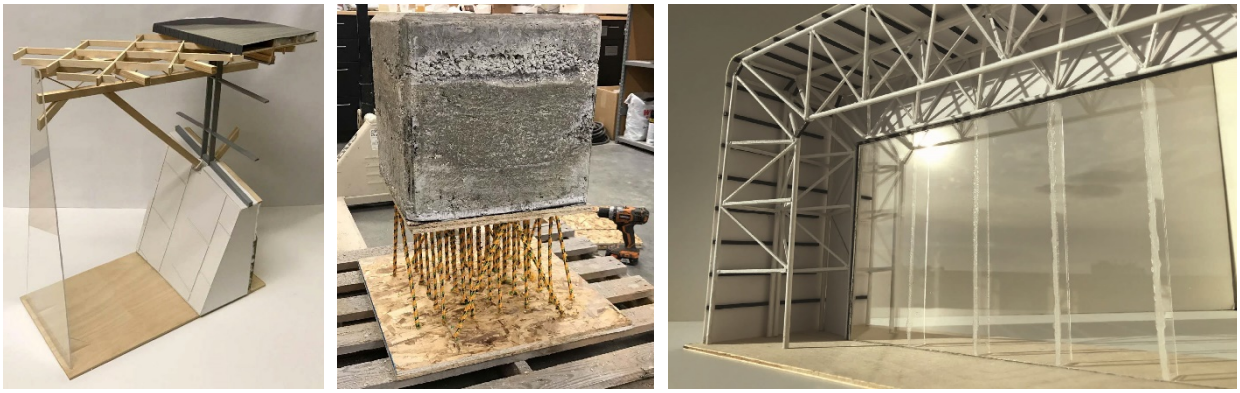

Fig.3 Examples of student work by Ryker Belnap from 1-Architectural Detail model for Integrated Architectural Design (Montoto, 2017), 2- "Concrete in Tension" model for Graduate Project Seminar (Teal, 2018)[24] and 3- "Sainsbury Center for Visual Arts" model for the Graduate Project Studio, coordinated by Randall Teal (2019)[25] with Carolina Manrique (2019)[26] as major professor.

One of the main challenges towards integration efforts, in general, is being able to track the process of students' work throughout the different courses in order to identify connections and potentialities. Providing the example of the student above has required tracing back the process from which his current graduate project topic emerged. Where did these connections suggested by the student come from? What triggered each of the steps? (e.g. an author, an exercise, a lecture, a conversation, etc.). In other words, what other strategies should we implement to trigger more creative integrations? Through the process of tracking back the work of this student and gathering the information of course guidelines and other work examples provided both by faculty and students has provided valuable information on methods and references.

Tracking these efforts establishing the opportunities towards integration also contributes to minimize the loss of continuity of positive approaches due to faculty turnover. Two faculty providing information from their courses for this paper are no longer in our program (one retired and the other is pursuing a PhD program abroad), and a third will leave at the end of spring 2019 to another institution. This paper serves the purpose of documenting some of the valuable efforts for further improvements to be developed by remaining and new faculty taking over these courses in the future.

Some of the opportunities towards integration strategies include minimizing the divide between knowledge areas. Our program makes a good effort in having all architecture faculty teach design studios in addition to lecture-based courses in their area of

expertise. Most faculty also teach both in undergraduate and graduate levels, and participate in each other's reviews. This interaction has allowed to understand how others are approaching their courses and have provided important feedback to improve processes and outcomes.

Key feedback usually comes with reference to specialized resources that faculty in their area of interest keep track off. For example, a faculty specialized in building performance recommends a textbook from Kiel Moe as required for the Technical Integration course[27]. Increasing collaborations with our program, with other programs in our college and the university, as well as expanding current partnerships with industry, will provide access to more technical and design resources for both faculty and students. Access to these resources are key to strengthen our theme-based design studios.

Other opportunities for more seamless integration efforts are related to the increasing use of references in courses that bridge the gap between architectural design and building technology. Some of the references used in our undergraduate structural system courses include "Form and Forces" (Allen, 2009)[28] and "The Structural Basis of Architecture" (Sandaker et al., 2011)[29]. Other references used in our structural systems courses are also required in architectural design studios coordinated at the same level such as "The Architect's Studio Companion" (Allen & Iano, 2017)[30] and "Building Structures Illustrated" (Ching et al., 2014)[31]. These textbooks are usually recommended in graduate architectural design studios in addition to more advanced readings aiming to provide further understandings of architectural technology and its relation to the design process. Other references suggesting opportunities for increasing integration efforts explore intersections of design and construction (Schwartz, 2017)[32] and relationships between "structures and the form and spaces of architecture" (Cruvellier et al., 2017)[33]. Expanding these references will contribute for reinforcing design-thinking as a goal.

Notes

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