Journal of Applied Sciences and Arts

Volume 1 | Issue 1 Article 2

2015

Debating the Merits of Design/Build: Assessing Pedagogical Strategies in an Architectural Technology Course

Chad Schwartz
Southern Illinois University Carbondale, chad.schwartz@siu.edu

Debating the Merits of Design/Build

Assessing Pedagogical Strategies in an Architectural Technology Course

Chad Schwartz - Assistant Professor

Southern Illinois University – Carbondale
School of Architecture

Abstract: The pedagogy of design/build can be deployed in a wide variety of ways in an architectural curriculum. Despite common goals - breaking free of the classroom, exploring through experiential learning, and imparting a well-rounded understanding of the practice of architecture - the particular construct of design/build utilized can significantly impact the overall quality of the educational experience for the students. As with most curricular constructs, the challenge is configuring projects to optimize student experience with the wide variety of constraints that come with the practice of building in an academic environment. This paper explores the introduction of design/build into a foundation level technology course. For the past three years, architecture and interior design students have actively engaged their education through participation in two different styles of design/build projects. The first involved the building of residential wall sections in an on-campus outdoor lab; the second was the design/build of an amphitheater for a regional environmental education center. After three years of building, this paper is a reflection on the successes and failures of the projects undertaken. The study is concerned with determining the best means of delivering this type of content and learning experience to architecture and interior design students within the construct of a technology course. Although only preliminary, the initial findings suggest that, despite its popularity, community-based design/build may, in some situations, not be the best choice for delivering experiential building content in architectural courses.
Keywords: *architecture, design/build, curriculum studies, construction*

1: Introduction

Design/build is a classification of architectural study in which students generate a conceived design and actively participate in transforming that design into a real structure or space. Although certainly not a new idea, over the past two decades this pedagogical construct has become increasingly popular in schools of architecture for its ability to deliver a number of critical lessons to students through first-hand experience. As of 2011, there were approximately 100 design/build programs underway in schools of architecture across the United States (Gjertson, 2011). "In some cases, design/build involves small structures built in and around the school; in others, the students spend weeks or even semesters living and building in places very remote from and very culturally different than their university classroom. In all cases, however, these courses involve the hands-on making of place by the students participating (Schwartz, 2014)."

Most design/build projects have similar core objectives: breaking free of the classroom, exploring through experiential learning, and imparting a well-rounded understanding of the practice of architecture. These courses commonly "remove design projects from the studio vacuum and push students to reconcile their drawings with real structures they can build, weld, wire, and plumb. They encourage students to work as part of collaborative teams, resolving conflicts, managing finances, and communicating with clients (Bilello, 1996, p. 145)." Yet the particular construct of design/build utilized can significantly impact the overall quality of the educational experience for the students.

Publications discussing the practice of design/build often refer to community-based endeavors. This practice has its roots in the dawn of the profession of architecture, but found its formal beginnings in the 1960's at Yale University with the introduction of the First Year Building Program. This program's first project, located in rural Kentucky, was sparked by a student who previously worked in the area with the Community Development Institute of Southern Illinois University-Carbondale (Schuman, 2012). The practice of design/build, therefore, grew directly from community activism and development. This community-based spirit is most notably documented in Auburn University's Rural Studio, founded by Samuel Mockbee and Dennis Ruth in 1992. For more than two decades, this program has ventured out into the surrounding economically-depressed area (notably Hale County) to construct a new living environment for the citizens that call it home. It was Mockbee's belief that "the architectural profession has an ethical responsibility to help improve living conditions for the poor," which begins by interweaving "a moral sense of service to the community" within the academic environment (Oppenheimer Dean, 2002, p. 1).

The ideals of the Rural Studio have sparked a slew of nationally and internationally recognized programs such as Studio 804 at the University of Kansas led by Dan Rockhill, Ghost Lab in Nova Scotia led by Brian MacKay-Lyons, and the Howard S. Wright Neighborhood Design/Build Studio at the University of Washington led by design/build pioneer Steve Badanes. All of these endeavors have built on the traditions of communal building as a means of conveying the lessons of architecture to students. Combined with the practical lessons of architecture, however, are life lessons about the value of community, people, and the greater responsibilities entrusted to those that affect the built environment. Despite the success of many of these programs, the pedagogy of design/build has been critiqued in recent studies, most notably in 2011 by Geoff Gjertson. In a survey of design/build programs across the United States, Gjertson found that less than 15% of the programs responding required students to engage with the practice of design/build. Despite the large amount of resources utilized to support design/build programs, how effective are they in reaching the majority of students passing through schools of architecture in the United States. Gjertson's findings are not surprising given that 93% of the respondents stated that their design/build courses operate in a studio-based model. Typically a design/build studio is one of several studios offered in a semester, giving only a percentage of the student population the opportunity to engage through this educational construct. Another limiting factor is the course enrollment. The ideal number of students for a design/build studio is between seven and ten to allow for appropriate division of labor, student focus, and efficiency within the group (Carpenter, 1997 & Gjertson, 2011). This construct poses two issues. First, it significantly limits the number of students the project has the ability to reach and, second, if the number grows to include more students the management of the project becomes cumbersome and learning outcomes may suffer.

While design studios focus on smaller groups with widely varying content frequently based on faculty interests, technical courses typically present information in a uniform manner to a single, large group of students. One technical course has the ability to affect a much broader audience than a single studio in most cases. These courses are often rooted in technical and practical material centered on construction and assembly practices, but rarely encroach into the domain of community engagement and social responsibility. Educator Sam Ridgway states:

> *It might be said that the practice of architecture in the twentieth century has become a battleground between art and science, neither of which properly represent architectural knowledge. Design, for example, is usually thought to be part of the creative and artistic domain and therefore irrational and mysterious, belonging to the world of culture and individual genius. Conversely, building technologies, the embodiment of this creativity, belong to the rational world of science and technology.* (2000, p. 18)

Ridgway and others have proposed reconceiving the way in which building technology courses are taught. From Ed Allen's proposition for a second studio centered on technical systems (1997) to Kelly Carlson-Reddig's proposition for a theory-based technology course (1997), many attempts have been made to more fully integrate technology with design in the conscious of architecture students. The incorporation of design/build pedagogy into a technical course has the ability to create these links as well, tying the creative outlet of design to the technical realities of constructing that design. Construction activities in technology courses are certainly not new. Most, however, are more likely to be categorized as material or assembly studies than they are to be called design/build work. These activities are far less documented and celebrated than their community-based counterparts based in the design studio. They have the potential, however, to be just as impactful (if not more so) on the student body.

This paper explores the introduction of design/build into a foundation level technology course. For the past three years, architecture and interior design students have actively engaged their education through participation in two different styles of design/build projects. The first involved the building of residential wall sections in an on-campus outdoor lab; the second was the design/build of an amphitheater for a regional environmental education center. Both design/build strategies presented opportunities for student learning and engagement. After three years of building, this paper is a reflection on the successes and failures of the projects undertaken. The study is concerned with determining the best means of delivering this type of content and learning experience to architecture and interior design students within the construct of a technology course. The results will be used to strategize future projects and to better understand how the course may need to restructure to take advantage of the best traits of the design/build pedagogy. Although only preliminary, the initial findings suggest that, despite its popularity, community-based design/build may, in some situations, not be the best choice for delivering experiential building content in architectural coursework.

2: Course Structure

This introductory technology course is a core offering in the architecture and interior design programs and centers on developing an understanding of wood construction. Taken in the spring semester, the primary course content is delivered through (2) one-hour lectures each week while (2) two-hour labs provide a forum for instruction in construction documents and Building Information Modeling [BIM]. The lab sessions also are the arena for the exploration of the course's projects. The student enrollment has varied significantly over the period of study, with 69 students (high) enrolled in 2012 and 43 students (low) in 2014.
This paper will focus on the course iterations taught in 2012 and 2014. In these years, the same set of three projects was utilized, allowing for a better cross-comparison and analysis. The first project involved the exploration of wood joints. The joints, built from 2x4s, were inspired by connections found in the students' everyday life (doorknob, necktie, bra strap, etc.). The second project was the design/build component and the subject of this paper. Finally, the third project centered on the generation of a small set of BIM manufactured construction documents for a single family residence.

2.1: Design/Build 2012

Design/build was introduced to this technology course in 2012. In the initial iteration, groups of six or seven students were presented with a sectional drawing of a single-story residence built using wood light frame construction. The students were required to study the drawing and develop a strategy for building a 4'-0" wide mock-up of the wall; the details, finishes, and unspecified components were the groups' responsibility to develop.

The working process for the project emphasized translation. Each group completed the design of the wall, generated a parts list from their design, created a cost estimate from the parts list, and, finally, developed a storyboard detailing the construction sequencing and scheduling. After all submittals were approved by the faculty, the student groups built their wall sections at full scale in an outdoor lab space on campus. The build was accomplished in a single day, with demolition coming the following week (Figure 1). After completion of the construction project, each group was required to submit a photo narrative of the process. The same project was repeated in the spring of 2013.

Figure 1: Students participating in the courtyard build project in Spring 2012.
Photographs taken by R. Swenson.

2.2: Design/Build 2014

In 2014, the course was awarded a grant from the University to initiate a design/build project at a regional environmental education center. The center is located within a 3100 acre forest preserve that serves a wide variety of University and non-University programs. Summer camps, corporate retreats, weddings parties, and many other groups utilize the grounds for events throughout the year. After a survey of the property and discussion with staff, the faculty decided to focus the efforts of the students on the rebuilding of a hillside amphitheater. The structure was in poor condition, but utilized frequently by the camp's guests. In addition to reaching the center's primary users, the project required no electrical, mechanical, or plumbing work; simplified engineering limited the interaction with the local unions to just the Laborers.
The rigorous working process established with the 2012 build was adapted to the complexity of this community based design/build. The class is divided into three lab sections. Each lab section worked on one facet of the project: the stage, the primary seating area, or the threshold and rest stop. The three components comprise a footprint of around 1400 gsf.

The amphitheater project began with a site visit. After this trip, the students worked in pairs to generate schematic designs for their facet of the project, coordinating with students in the other labs to create cohesive design strategies for the overall project. The class voted on the top schemes and presented them to our client - the center staff - for review. After receiving a decision, each lab was divided into four task groups for project development with three to four students assigned to each group. The timeframe and project scope necessitated each group to focus on specific tasks: material list and cost analysis, storyboard and construction sequence, site analysis and construction documentation, or mockups and models. This process required significant coordination between task groups and between lab sections. At the conclusion of design and documentation, the project moved to the site (Figure 2). Students were required to attend three build days and were rewarded with extra credit for attending additional days. As with the previous builds, at the conclusion of the project each group was required to contribute to a summary document of the project's process.

Figure 2: Students participating in the amphitheater build project in Spring 2014.
Photographs submitted by S. Jariwala.

3: Project Analysis

After three years of integrating build projects into this foundation level course, an analysis was required to study the effectiveness of the two distinctly different project types. This study is not intended to be a critique of the practice of design/build or of the overall learning experience of the course. Instead, it is an examination of the ability of this project typology to provide successful learning outcomes and positive experiences for the enrolled students. It is also a means of assessing the relative successes, failures, and complications present in each build. The two design/build projects were compared with regards to their general traits, ability to fulfill the course's learning objectives, ability to coordinate with the other course projects, impact on student performance, lessons delivered, associated costs and funding issues, and ability to activate the School of Architecture.

Two considerations should be noted regarding this assessment. First, the wall section build project was generated while redesigning the overall course structure. This iteration of the build, therefore, was designed specifically to work within the construct of the course and its objectives. The amphitheater build, on the other hand, was an experiment to help understand how community based design/build would work in this type of course. The rest of the course was not modified in any meaningful way to accommodate the shift in the design/build project. The amphitheater build brought some unique qualities to the class that the wall section build did not, but it was virtually impossible for it to have outperformed the original build in this study. And second, this study does not project the ability for either project to be modified or for the course itself to be modified. For instance, a community-based design/build can be significantly less complex than the one undertaken in 2014. Similarly, a wall section build can be conceived to reduce the material waste encountered in 2012. These possibilities were kept out of the study in favor of focusing on what actually occurred. The results of this analysis will be used to develop future projects that optimize the learning opportunities for the architecture and interior design students in the School of Architecture.

3.1: General Considerations

There are three general considerations that must be discussed with respect to the integration of build projects into this course: time, enrollment, and location. This course is one semester long; it, like most courses, operates in a fixed timeframe. Most design/build projects occur in design studios. A studio typically has around twelve hours of dedicated classroom time each week, earns the student five hours of course credit, and stands as the centerpiece of a student's education in the program (these statistics will, of course, vary per university). In a design/build studio, a group of students may spend the first half of a semester designing a project and the second half of the semester building the final product. Twelve hours per week for eight weeks (assuming semesters and not trimesters) would result in 96 hours spent on construction, just within the confines of dedicated class time. Most functional design/build courses have the build serve as the out-of-class work as well, extending the amount of build hours available considerably. With a manageable group of students and a significant amount of contact hours, these courses are ideal homes for the complex and demanding environment of a design/build project in the community that Mockbee lovingly referred to as 'going to war.'

In contrast, each student in this lecture/lab course spends six hours in class each week and receives three hours of credit for the course. During the semester, they are also enrolled in a design studio and other core classes. Taking into account the rest of the course requirements (and the rest of their semester schedule), it was determined by the course faculty that the assigned build timeframe for the construction in this class could not exceed three scheduled class days. As a result, the students have a maximum of nine hours - (3) three hour days - of dedicated class time assigned to construction - less than 10% of a studio. These three days could be extended to full days of work running from approximately 6:00 am to 6:00 pm.

In 2012, the students were able to build the wall section projects in a single, twelve hour day without significant issues. The second build day was utilized for demolition of the structures, which took only a few hours, and for salvaging and storing recyclable materials for future use. The third allocated day was not needed for the build. This project optimized the limited timeframe of the build portion of the course, even returning some of the allocated time back to the students to complete other required coursework.

In 2014, the students utilized the full three required build days relatively well. The coordination was much more complex with this project and, as such, there was some time lost throughout the three day period as the group (including the faculty leadership) established its working process and coordinated all of the moving parts. The three day period was not sufficient, however, for completing the amphitheater project. Seventeen additional build days (all partial days) were required to do so. Upwards of twenty students participated on any given day and, in total, about 70% of the students in the class provided additional labor for the build. The time required to build the amphitheater project was detrimental to student learning outcomes as many of the valuable learning experiences design/build has to offer came after the mandatory days had passed.

The high enrollment of the class also proved challenging when undertaking a design/build project. In 2012, the large number of students was able to be broken into small groups due to the scale of the wall section. The relative similarity of each group's work made the coordination of the class of 69 students manageable. The location of the project also played a significant role in managing the large number of students. The School's outdoor lab is compact. It provided enough room to work and it was relatively easy to supervise the entire class in the contained environment. All materials needed were brought onto the site at the beginning of the day and all of the power tools used for cutting were kept at a single workstation. This format allowed for the large enrollment to be broken into manageable pieces, similar to a studio environment, but also allowed for close observation of all parties involved to help maintain a safe and productive jobsite.

In 2014, the course enrollment dropped 33% from 2012. In theory, this smaller group of students should have allowed for a more manageable situation. This premise, however, did not prove to be true in practice. The amphitheater could not be divided into small components as easily as the wall sections. Instead, it could only be subdivided into three zones, one for each lab of twelve to sixteen students. Each lab of students was then subdivided into task groups concurrently working on separate aspects of their zone of inquiry. This construct of groups within groups within a whole created the need for a more complex system of communication. This system proved to be a positive learning experience for some, but a source of added stress and complication for most of the individuals involved. In his book Learning by Building, design/build expert William Carpenter states that he attempted to organize a design/build studio with 19 people once and that it 'nearly killed him (1997, p. 10).' This lab was the equivalent of three studios operating simultaneously.

Also adding complexity was the nature of the jobsite. The amphitheater was built away from the controlled environment of the lab, out in the community. The class worked on four separate jobsites throughout the project separated by up to 1,000 feet along a forested hillside: the main amphitheater site, a secondary build location up the hillside, a workshop set up in an open-air pavilion, and the supply drop in the parking lot. All four sites were continuously occupied with active work and were completely invisible from each other. The configuration made monitoring the large group of students difficult. They were divided into smaller groups to work on segments of the amphitheater build, but the inability to continually monitor the entire group of inexperienced students led to disappearing students, standing around, and a general loss of productivity.
In both 2012 and 2014, the high student enrollment of the technology course was able to be subdivided to create groups more in line with the ideal headcount promoted for a typical design/build studio. However, this subdivision into groups meant that multiple teams had to be ushered through the semester concurrently in a much shorter timeframe than available in the studio model. The wall section project utilized repetition of design and a controlled build environment to help manage the multiple working groups. The amphitheater build, on the other hand, attempted to replicate a studio design/build model that failed to work reasonably within the timeframe and was, at times, compromised by the breadth of the physical area of the jobsite.

3.2: Course Learning Objectives

Introductory technology courses have a series of objectives, derived from multiple sources that need to be met for them to succeed as learning environments. In this case, the course draws objectives from four sources: the School's master syllabi, the accreditation boards for both architecture and interior design (The National Architectural Accrediting Board [NAAB] and the Council for Interior Design Accreditation [CIDA]), and the curricular imperatives of the course faculty. Figure 3 displays these objectives, indicating which objectives have been assigned to each course component and describes how well they are met for the design/build project.

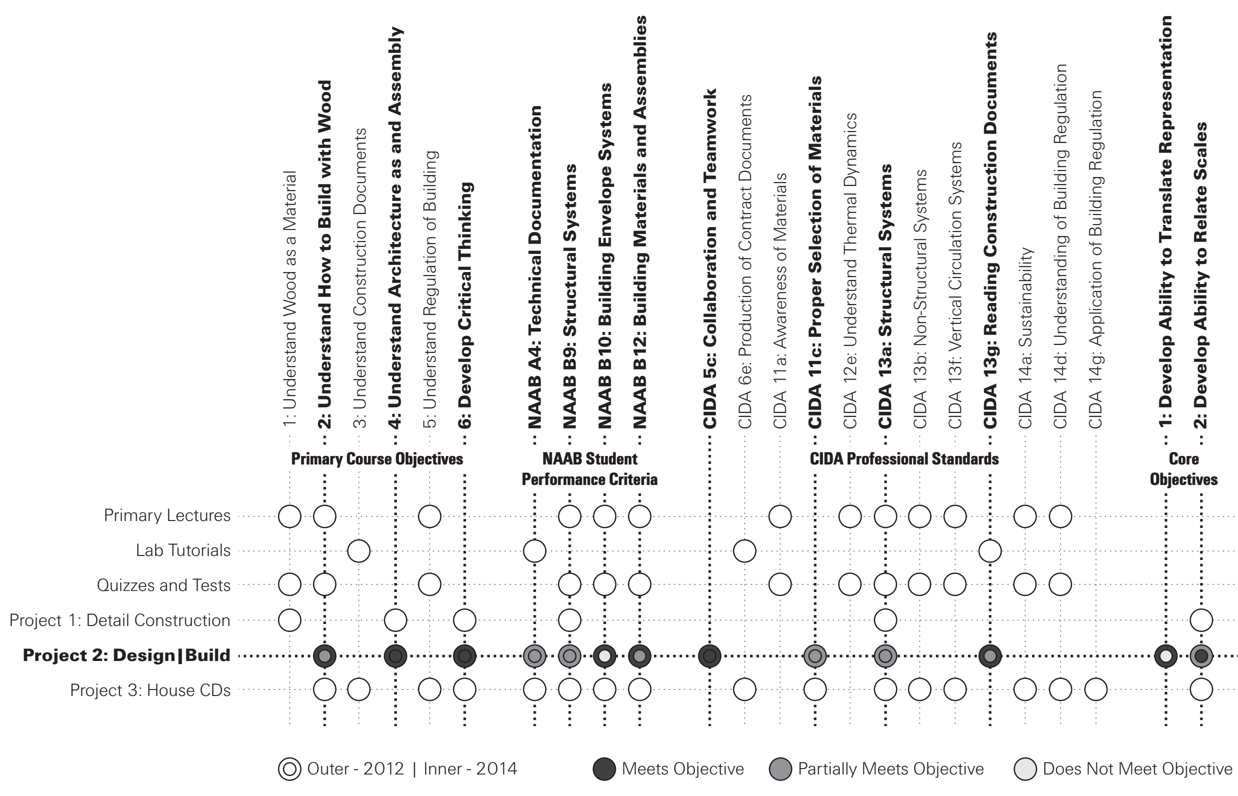

Figure 3: Chart of assigned and allocated course learning objectives.

Thirteen of the twenty-four objectives assigned to the class are associated with this design/build problem. Each was studied to better understand the ability of the two iterations of the build project to fulfill the course requirements. For each objective, a list of considerations was made that outlines how each project met, partially met, or did not meet the learning objective. Figure 4 presents a demonstration of this analysis. For all but two of the learning objectives assigned to the design/build project, other components of the class are also responsible for assisting in meeting their goals. Therefore, a result of "partially meets objective" or even "does not meet objective" does not mean that the students are not fully attaining the goals of that learning objective within the construct of the entire course, just not within this course component. Although outside the scope of this paper, this full analysis can be found in the author's "Constructing Experience: Exploring Design|Build Strategies within a Technology Course (Schwartz, 2014)."

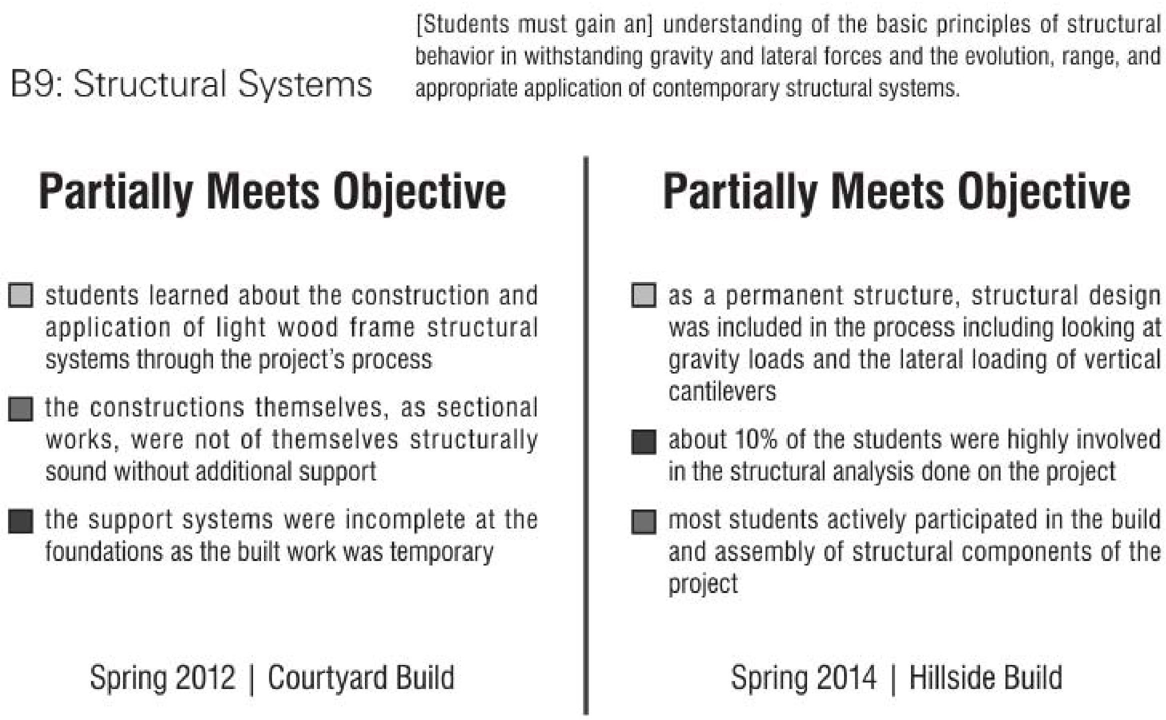

Figure 4: Sample analysis results of Building Technology I course learning objective study.

The wall section build project received eight counts of meeting the objective, five counts of partially meeting the objective, and zero counts of not meeting the objective. The amphitheater build received four counts of meeting, seven counts of partially meeting, and two counts of not meeting. Although by this metric the wall section build outperformed the amphitheater project, it should have as it was designed to meet the objectives.

The amphitheater build was inserted into the course without modifying the objectives to account for its potential strengths and weaknesses. It is far superior to the wall section build with respect to community and service learning. Those objectives are present in many design studios, but rarely appear in the goals of most technology courses. The shifting from lab-based to community-based building created a new set of potential objectives that could be satisfied. Tapping into the strengths of this project typology, however, would likely involve modifying the course's objects, which could impact on the general curriculum of the School of Architecture.

3.3: Project Coordination and Student Performance

The three projects utilized in this course were originally conceived to complement each other through differing scales. Project 1 explores the detail; Project 2 (the build) originally looked at the section; and Project 3 examines the full building. In 2012, the three projects complemented each other well. In particular, the wall section build and the construction document set of a small single family residence built on the same lessons of residential construction and investigated the proto-typical makeup of wood light frame construction. As the students worked on both problems simultaneously, lessons learned were able to be readily carried back and forth between them. In addition, ideas of making, materiality, and assembly were laced through both the initial detail investigation and the wall section build.

In 2014, the amphitheater project coordinated well with the detail study. The more creative design/build project allowed the students to incorporate ideas from their detail studies into the design of the amphitheater. The understanding of joinery was critical to the students' ability to determine the proper attachments necessary in the larger work. The relationship between the design/build project and the construction document set, however, was minimal. They both looked at normative construction practices in wood, but the applications were radically different outside of the construction of the amphitheater stage. Conversations with students since point to the two projects competing for attention more than providing a complementary learning experience.

These conversations are reinforced by student performance data. It was relatively impossible to compare the performance of the students on the design/build projects themselves. There are many facets to those grades, which were different in the two comparison years. The work was also done in a group setting, which can create irregularities due to students being carried or hindered by the rest of the group. Instead, the concern is with the performance on the construction document set submitted for Project 3, which runs concurrently with Project 2.

The students create two sets of drawings for Project 3: a preliminary design development [DD] set and final construction document [CD] set. The latter is simply an improved and more detailed version of the former. In both semesters, the DD set was due week 11 of the semester, the build for Project 2 started in week 12 or 13, and the CD set was due in week 15. In 2012 the class average went up 4.1% from the DD submittal to the CD submittal. In that same year, 85% of the students in the class who submitted both drawing sets performed better on the second submittal than the first. In 2014, the average score between the DD and CD submittals was only +1%, less than 25% of the change in 2012. More significantly, only 58% of the class earned a higher score on the CD set than the DD set, a monumental decrease in overall performance. In 2012, the average score on the CD submittal was 85.4%, but in 2014 that average dropped 5.2% to 80.2%. For comparison, the average final score in the class in 2012 was an 84.1%, while the same average in 2014 was an 82.7 - only a loss of 1.4%. Although the class performed slightly worse in general in 2014, the radically different scores on the CD set indicate that something was negatively impacting their performance. Although there are many other factors this decrease could relate to, it is likely that the performance drop can at least be partially (if not completely) attributed to the complexity and added workload of the amphitheater project, which was occurring while the students were also preparing their CD documents for Project 3.

This analysis also marks a distinct departure from the design/build studio. Rarely would the studio have other work occurring that was not a component of the build itself. In a technology course, which is at least partially data driven in nature, a series exercises, lectures, and other components frequently are employed to convey this type of information. Incorporating "design" into a technology course requires that it integrates into this balancing act successfully. Whereas in studio the design/build is the entirety of the exploration, in the technology course it is frequently one of many devices used to convey critical learning experience.

3.4: Learning Opportunities

This overlap of experience is also pertinent to a discussion of opportunity. As stated above, technology courses are frequently data or information driven and, as such, they are responsible for delivering that information to each student in the class equally. The most prominent factor limiting equal learning opportunity in a design/build project is a division of labor. In most studio based design/build projects a division of labor is a necessary curricular construct in order to accomplish all of the required tasks in the project timeframe. However, the large number of contact hours and relatively small number of students allows for information to be passed quite readily, ensuring that all project participants understand the whole project relatively well. With much higher student enrollment and more limited contact hours, disseminating information to all students in an introductory technology course is a significantly greater challenge. In this environment, more of the responsibility falls on the students to prepare themselves outside of class by seeking out the information. The more flexible and exploratory learning environment of the design studio also may warrant (or even seek out) differing learning experiences, while the more structured construction of most technology courses resist that differentiation.

In 2012, the students were separated into small groups. All tasks were completed in succession, with no tasks worked on concurrently. Students not directly working on a particular task had every opportunity to pay attention to what was being accomplished. Iteration was also utilized throughout the process to refine the work and provide more opportunity for student contact with the lessons. With minimal effort, each student had the opportunity to receive a similar learning experience from the project. Based on observation, student performance, and student evaluation results, most of the students working on the wall section project did, in fact, have a similar experience.

In 2014, the project was significantly different with respect to opportunity for learning experiences. Again, the students were divided into smaller groups, but as previously mentioned, due to the complexity of the build and timeframe a significant portion of the work had to be done concurrently and the work was not iterative. And, as most of the students were absorbed in their assigned tasks, they did not have the time or ability to fully understand the work done by other students or task groups. As a result, the learning experiences varied distinctly from student to student. Only a handful of dedicated students took the time to fully investigate all four primary areas of development (cost estimating, CDs, storyboard, and mockups/detailing). In a design studio, this likely could have been resolved, but in this course it resulted in a significant number of students lacking the knowledge necessary to construct the final product.

The difference between the two groups was evident during the build. In 2012, the groups were remarkably prepared. They had questions throughout the day, but self-sufficiently worked through their construction without too much hand-holding. In stark contrast, the students constructing the amphitheater required significant guidance to even understand what they were supposed to build. Many of the students had to be walked through the basic premises of what was to be constructed because they had not thoroughly reviewed their own group's documentation outside of their own part of the work. The majority of these students were likely unable to make the critical connections between the work done in the classroom and the work done on the jobsite that provided the predominant learning experience in 2012.

3.5: Costs and Funding

Funding is critical in the pursuit of academic design/build work. Unlike most academic work that resides in a fictional construct of paper, cardboard, and digital representations, design/build projects operate in the real world of material and assembly. That reality must be purchased, found, or donated. The wall section build was a student funded project. Each group paid for their own construction, which averaged around 300-400 dollars after a generous discount provided by a national home improvement chain. Despite initial unhappiness about having to spend their own money on the project, several students commented in the years since that having to pay for the work themselves made them much more conscious of the costs involved in constructing architecture. This means of funding is certainly easy to plan for, but is relatively limited in scope. Without significant discounts, this project would have been too expensive for the students to afford (an issue confronted with the same project in 2013).

While lab-based design/build projects have the opportunity to be funded by participants, community-based design/build work almost always has to be funded by outside sources. The amphitheater build was fully funded by the University through a grant of 10,000 dollars. The removal of the burden of financing from the students altered their relationship with the built work. The stresses of collecting money from group members and financing the work was gone, but so was the incentive to build smart and cost effective. Fortunately, this loss of responsibility was more than made up for by the permanence of the structure.

Permanence is another cost related issue. The wall sections had a lifespan of one week and had little lasting impact on anyone outside of the students enrolled in the class. Although a wonderful learning experience, the temporary and wasteful nature of the project was a significant issue. The salvageable lumber was recycled for future use (and it did get used), but at the end of demolition there was a full dumpster of material waste going to a landfill. The amphitheater, however, is a permanent structure that will impact thousands of people in positive ways. The materials purchased for the project were used efficiently with minimal waste, partially due to critical thinking in the design process and partially due to successful project management.

3.6: Impact on the School of Architecture

The wall section build activated the School of Architecture. Over the single day of building, students from all levels of the program joined the class in the outdoor lab (which is adjacent to the School) to participate in the build event. Most of the School's faculty joined as well, many serving as additional assistants and teachers on the jobsite. In addition, the top group in the class built their wall section in the School's gallery which is adjacent to the lab. This construction remained fully intact through the end of the year. It provided a positive talking point for visiting potential students and their families and was part of the SOA's presentation for its NAAB accreditation.

The amphitheater build, however, was located remotely from the School. Very few students outside of those enrolled in the course came to participate in (or even see) the work and only one faculty member visited during construction. Within the School of Architecture, the project essentially did not exist. Although certainly a positive talking point for the School, the College, and the University, the ability for the project and its processes of building to generate activity and engagement outside of the class was minimal. This point is essential for a discussion of lab-based versus community-based design/build. Most studio centered design/build courses construct their projects in the community. Sometimes the community is nearby, but other times it is quite distant from the school. Regardless, the separation of activity from the immediate vicinity of the school creates a lag in interest and impact. This loss is potentially balanced or superseded by the impact on the community itself, but that again comes back to the goals and objectives of the course, the course faculty, and the School.

4: Conclusion

Community-based design/build is seductive. We are seduced by the idea of making with a purpose; we are excited by the imagery of well-established design/build programs. And we should be. The phenomenal work coming out of the established design/build programs in this country is the result of strong leadership and vision, positive relationships, and hard-working students. However, students and faculty alike can be drawn in to believing that this work is the only viable strategy for design/build. It is easy to pursue the image of design/build without considering the relationship this type of pedagogical construct will have with the existing situation in a given course structure. It is pertinent to reflect on how rich and rigorous the process is for the student body. Each situation has its own unique variables that require different approaches to the pedagogy. Of chief importance to consider is that the seduction of design/build frequently lies in the finished work, but the educational experience is based on process, not on product.

In “Some Notes on the Phenomenology of Making,” Robert Morris discusses George Kubler’s examination of the Incan city of Machu Picchu:

> *[Kubler] is startlingly alone among art historians in his claim that the significant meanings of this monument are to be sought in reconstructing the particular building activity - and not in a formal analysis of the architecture. I believe there are ‘forms’ to be found within the activity of making as much as within the end products. These are forms of behavior, aimed at testing the limits and possibilities involved in that particular interaction between one’s actions and the materials of the environment* (Morris, 2010, p. 541).

Regardless of the final products created, the real critique of design/build needs to focus on Morris’ “forms” of working, thinking, and making that students develop throughout the project. As they move on in their academic and professional careers, design/build has the potential to have a critical impact on the student’s outlook on the profession of architecture and, in turn, on the future built environment. This impact will be felt due to the process they have endured, however, and not the seductive image of the built work. The prominent studio-based programs certainly are conceived around the development of experience through process. In “The Thought of Construction,” Robert McCarter describes his experiences working with MacKay-Lyons in the Ghost Lab. Amongst many agendas, he states that the most important is “the integration of the thought of construction through the construction of experience, realized in the group’s shared act of designing and building (2008, p. 208).” In this environment, “thinking and making, construing and constructing are joined irrevocably in enacting a work of architecture (McCarter, 2008, p. 193).” Although Ghost Lab operates outside of a formal academic setting, its counterparts within the university hold similar ideals.

But why are these experiences so often associated only with studio-based courses? In 2012, Joan Ockman edited a comprehensive book entitled Architecture School: Three Centuries of Educating Architects in North America. Within it is an essay by Richard W. Hayes on the history of design/build. Hayes does a masterful job of outlining the history of the pedagogy, but continually refers to the evolution of “design/build studios” or workshops, not design/build courses or practices. The assumption is clear that design/build is supposed to take place in the design studio. There certainly are a slew of valid reasons as to why design/build is rarely considered an option for a lecture/lab course. As previously described, the lower number of contact hours, the higher student enrollment, and the constant competition with design studio for student attention all point to issues in coordinating a typical design/build project.

But, it may be time to rethink what it means to teach technology courses in academia. What forum is more suited to discussing thoughts on construction than in a course dedicated to teaching students about construc-

tion practices? Certainly the opportunity is there for the taking, but what it will entail is rethinking the way in which these courses are structured and the way in which design/build is structured. Dozens of articles over the past 20 years have chided the way in which technology is relegated to second tier status below the heralded design studio. Yet virtually every proposal for a solution to this issue involves transferring technical knowledge into the studio environment. Why should this practice not occur in reverse? Design/build in a technology course has the potential to grow directly from the lessons of construction and assembly. Design, guided by real constraints, offers a significant platform for learning, especially for novice students still in their first years in the program. This course typology also has the advantage of reaching almost every student that passes through the school, something most design studios will never be able to accomplish.
This reflection on the past three years has illuminated significant successes, but it has also revealed critical flaws in this integrative process that require further refinement. To make this pedagogy work within a technology course, balance must be achieved with respect to scope, enrollment, and time. The process-driven construct must be rigorous, iterative, and engaging for all members of the class. And, of course, the projects undertaken must serve to promote the assigned learning outcomes and the ultimate success of the students. Foundation technology can push beyond lectures and demonstrations to actively engage students in the processes of construction and assembly. Design/build is one potential avenue to allow this to happen.

Overall, the student's work to-date has been successful (Figures 5 and 6) and the future of design/build in this foundation technology course is bright. A third iteration of the project is currently underway that looks to maximize the benefits of the builds from 2012 and 2014. Working in the same environmental education facility, the class is charged with designing and building restroom enclosures for a series of six grant-funded composting toilet units that will be distributed throughout the property. This arrangement allows for the class to be divided into six groups of eight to nine students all working on separate constructions in a similar fashion to the work done in 2012. The work itself, however, falls directly in line with the community-based efforts experienced in 2014 and carries similar issues of being a real project with a client, a timeframe, and a user group. The hope is that this version of the project will serve as a bridge between the previous projects and as a catalyst for new projects in the future. Based on this study, the coming years will likely see new projects that enhance the learning process of the students in the School of Architecture. Through their first hand participation in the construction of our built environment, they will become more knowledgeable about the realities of architecture as they move on to their professional careers.

Figure 5: Finished wall sections - 2012. Photograph by author.

Figure 6: Finished amphitheater - 2014. Photographs by author.

Bibliography

Allen, E. (1997). *Second Studio: A Model for Technical Teaching.* Journal of Architectural Education, 51(2), 92-95.

Bilello, J. (1996). Learning from Construction. *Architecture,* 85(8), 145-152.

Carlson-Reddig, K. (1997). Students Consider Architecture's Materiality. *Journal of Architectural Education*, 51(2), 96-104.

Carpenter, W. (1997). *Learning by Building: Design and Construction in Architectural Education.* New York: Van Nostrand Reinhold.

Gjertson, G. (October 6, 2011). *House Divided: Challenges to Design/Build from Within.* Paper presented at the 2011 ACSA Fall Conference, Houston, Texas, .

Hayes, R. W. (2012). Design/Build. In J. Ockman (Ed.), A*rchitecture School: Three Centuries of Educating Archi tects in North America* (pp. 286-290). London: The MIT Press.

McCarter, R. (2008). "he Thought of Construction. In B. n. a. e. MacKay-Lyons (Ed.), *Ghost: Building an Architectural Vision* (pp. 190-209). New York: Princeton Architectural Press.

Morris, R. (2010). Some Notes on the Phenomenology of Making: The Search for the Motivated. In G. Adamson (Ed.), *The Craft Reader* (pp. 540-547). New York, New York: Berg Publishers.

Oppenheimer Dean, A. (2002). *Rural Studio: Samuel Mockbee and an Architecture of Decency.* New York: Princeton Architectural Press.

Ridgway, S. (2000). Building a Site for Thinking: Teaching First Year Building Construction. *Architectural Theory Review*, 5(2), 14-26.

Schuman, A. W. (2012). Community Engagement. In J. Ockman (Ed.), *Architecture School: Three Centuries of Educating Architects in North America* (pp. 252-259). London: The MIT Press.

Schwartz, C. (2014). *Constructing Experience: Exploring Design|Build Strategies within a Technology Course.* Paper presented at the Working Out | Thinking While Building: 2014 ACSA Fall Conference, Dalhousie University, Halifax, Nova Scotia, Canada. (forthcoming)

Schwartz, C., Morthland, L., & McDonald, S. (2014). Building a Social Framework: Utilising Design/Build to Provide Social Learning Experiences for Architecture Students. *Architectural Theory Review,* 19(1), 76-91.