AN EXAMINATION OF DESIGN/BUILD PROJECTS IN THE EDUCATION OF AN ARCHITECT

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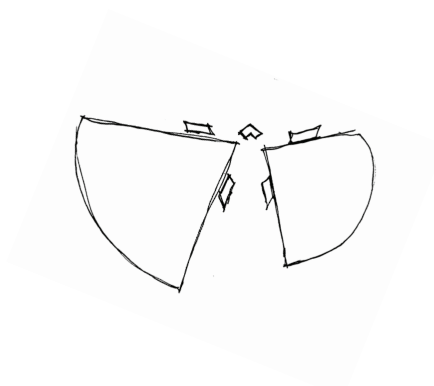
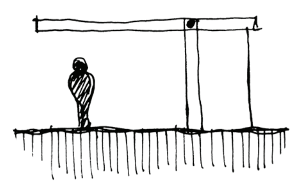
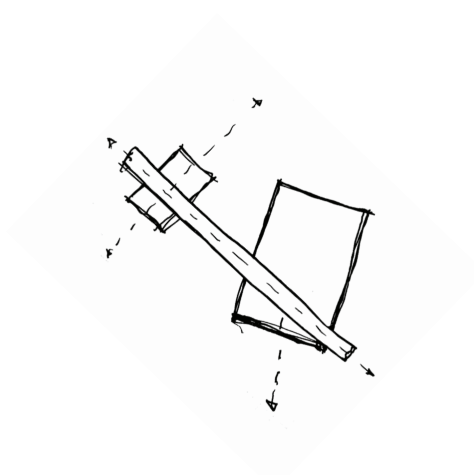
ABSTRACT

THIS THESIS AIMS TO PROVIDE AN EXAMINATION OF DESIGN/BUILD PROJECTS AS A MODE OF EDUCATING ARCHITECTS FROM THE PERSPECTIVE OF A RECURRING STUDENT PARTICIPANT. CONTEMPORARY SCHOLARLY ARTICLES ARE SYNTHESIZED WITH THE OBSERVATIONS OF A STUDENT WITH A RANGE OF EXPERIENCE TO FORM A POSITION ON THE PLACE AND PURPOSE OF DESIGN/BUILD IN ARCHITECTURAL EDUCATION. ADDITIONALLY, THESE CONCLUSIONS ARE USED TO FORMULATE AN OUTLINE OF THE IDEAL DESIGN/BUILD COURSE FOR ARCHITECTURE STUDENTS.







THIS THESIS IS DEDICATED TO EVERYONE WHO HAS HELPED ME ALONG THE WAY. THANK YOU.

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FOREWORD


FIG. 1 | Students from the design/buildLAB meet to discuss precedent work.

THE DISCUSSION OF DESIGN/BUILD PROJECTS IN THIS PAPER IS SPECIFIC TO THOSE CONDUCTED BY STUDENTS OF ARCHITECTURE AT A COLLEGIATE LEVEL. ADDITIONALLY, IT MOST DIRECTLY APPLIES TO THE AMERICANIZED SYSTEM OF EDUCATING ARCHITECTS. HERE, THE TERM "DESIGN/BUILD" IS USED TO REFER TO ANY PROJECT WHERE STUDENTS TRANSLATE ARCHITECTURAL IDEAS FROM THE DRAWN PAGE TO THE CONSTRUCTED REALITY. THIS PAPER AIMS TO OUTLINE AN "IDEAL" DESIGN/BUILD PROGRAM. WHILE IT IS UNDERSTOOD THAT EVERY PROJECT IS DIFFERENT AND ADHERING TO SUCH GUIDELINES IS NOT ALWAYS POSSIBLE, THIS MODE OF THINKING IS HELPFUL TO FORMULATE A STRONG IDEA OF WHAT MAKES AN EFFECTIVE DESIGN/BUILD PROGRAM. THE CONCLUSIONS ARE INTENDED TO SERVE AS A REFERENCE FOR EDUCATORS WITH AN INTEREST IN USING DESIGN/BUILD PROJECTS TO EDUCATE ARCHITECTS.

FIRST, TO ESTABLISH PERSONAL GROUNDING, THERE IS A SUMMARY OF MY OWN EXPERIENCES WORKING ON DESIGN/BUILD PROJECTS AS A STUDENT. SECOND THERE IS A BRIEF OVERVIEW OF CURRENT WRITINGS TO ILLUSTRATE WHERE THE TOPIC OF DESIGN/BUILD PROJECTS PRESENTLY STANDS IN THE EYES OF EDUCATORS. THIRD, TO PROVIDE A CLEAR DIRECTION, THERE IS AN EXPLANATION OF THE ROLE DESIGN/BUILD PROJECTS SHOULD PLAY IN THE EDUCATION OF AN ARCHITECT. FINALLY, THERE IS A DETAILED DESCRIPTION OF THE WAY DESIGN/BUILD PROJECTS SHOULD BE CONDUCTED BASED ON THE CONCLUSIONS FROM THE OTHER THREE SECTIONS.

AUTHOR'S EXPERIENCE

UNDERSTANDING THE PERSPECTIVE OF STUDENTS IS KEY WHEN EXAMINING ARCHITECTURAL EDUCATION. WITH THIS IN MIND I WOULD FIRST LIKE TO OUTLINE MY OWN EXPERIENCE AS A STUDENT IN DESIGN/BUILD PROGRAMS. AS BOTH A GRADUATE AND AN UNDERGRADUATE AT VIRGINIA TECH, I HAVE PARTICIPATED IN PROJECTS VARYING IN DEGREES OF INVOLVEMENT, COMPLEXITY, AND SCALE. FOLLOWING IS A DESCRIPTION OF THE PROCESS FOR THREE SEPARATE PROJECTS: THE FIELDS PROJECT, THE BIKE SHELTER PROTOTYPE, AND THE TRAIN-VIEWING PLATFORM. EACH DESCRIPTION INCLUDES A BRIEF DISCUSSION OF THE PROJECT'S STRENGTHS AND WEAKNESSES.

FIG. 2 | Dugout interior emphasizing the light passing between folded steel benches.

FIELDS PROJECT

During my third year, I participated in the design/buildLAB at Virginia Tech. The program was a two semester studio course in which twelve other students and I designed and constructed a Little League park for the town of Clifton Forge Virginia.

The first semester was devoted to the design process. After visiting the site and meeting with members of the Little League, each student was tasked with presenting a design for the park at a relatively small scale. Then, students were paired based on affinity between designs, and each pair created a new proposal at a larger scale which incorporated the strongest ideas of each individual. After presenting this set of schemes, pairs were then grouped into teams of four which were again tasked with making a new proposal incorporating the strong points of each previous design and again increasing in scale. The resulting three schemes were then presented to members of the Little League and, finally, merged into a single coherent scheme based on feedback from the community.

During the final merging of schemes there were a few disagreements regarding the form of the park's press box tower and backstop fences. These were resolved by the entire studio spending a day to collectively iterate using study models until an agreeable form was achieved. Otherwise, this method of design provided a smooth means of merging the ideas of thirteen people into a whole which was agreeable to everyone. The process was paced such that the final design was known by the end of October.

The second half of the fall semester was spent getting specific. The details of budget, building code, structure, earthworks, materiality, and prefabrication were examined more carefully, and students were assigned responsibility for different parts of the project. Conversation with engineers, officials, vendors, and visiting lecturers informed and developed the design more fully. By December, the design was understood comprehensively, and a loose set of construction documents was begun. The first semester was finished off by an exhibit of all the design and process work displayed collectively.

The second semester began with production of construction documents. The studio worked in AutoCAD to produce a cohesive set, and one person was tasked with curating the master file. The construction documents were printed and redlined daily by professors, and a permit set was completed by the end of February. Concurrently, students began compiling material lists and contacting suppliers. Requests for material donations were made, and the budget was consulted and edited throughout. Where necessary, shop drawings were produced to detail specific parts of the project.

As soon as the permit was issued, grading began on site. Meanwhile, in Blacksburg, prefabrication of the structures was started. For the first month of construction, a small number of students traveled to the site daily to work on trenches, excavations, drainage, and ground cover. The rest of the studio completed much of the framing and welding. Several of the more complex components such as the dugout benches and scoreboards were hired out to professional fabricators. In May, the entire studio moved pouring concrete on site so that the foundations and walls would be properly cured before the day where everything would be craned into place. Additionally, the plumbing and electrical work was completed during this time. By the end of the school year, the site work was finished and the prefabricated structures neared completion.

The project ended up continuing through the summer. Most of June was devoted to finishing all of the prefabricated structures. The painting, plumbing, hardware, and finishes were all completed before shipping the pieces. The smaller parts were taken to the site as they were ready, while the larger structures were kept in Blacksburg until crane day. To minimize the amount of time with an operator on site, the largest structures were both transported and craned into place on a single day in the middle of July. After securing them in place, the next month was spent completing the tasks which required being on site. By the end of the summer there were only a few minor details which remained.

The grass on the fields was left to grow for the fall, and then one weekend the following spring was spent preparing the fields for opening day. The park was photographed while the Little Leaguers and their families were enjoying it for the first time. While it is easy to criticize the project's enormous scope, and protracted timeframe, the design/buildLAB provided the most comprehensive design/build experience by far. The level of student involvement in the process, the scope of the project, and the dialogue with the receiving community presented architecture to the students in a manner which felt both genuine and complete.

FIG. 3 | The fields' press box tower being hoisted into place on crane day.

FIG. 4 | The completed project including two baseball fields, two backstops, two storage units, four dugouts, and a press box tower .

BIKE SHELTER PROTOTYPE

I spent spring semester of my fourth year working on a prototype for a bike shelter with two other students. We designed a system which could be repeated to form a shelter and bike rack and then built one section at full scale as a demonstration.

For this project the design process was far more concise. One design was chosen from the beginning, and slight improvements were made as structural, material, and budgeting concerns were made evident. Revisions were made at the scale of the detail rather than at the scale of the overall scheme, and few people were consulted outside of the team. Because the project was constructed at a testing facility, comprehensive construction documents and a building permit were unnecessary. It was possible to acquire most of the materials from local hardware stores, and most of the funding initially came out of pocket.

The construction process for the shelter prototype was similarly more rapid. The components were all fabricated in the school's metal shop and wood shop. Individual pieces were then transported to the site and assembled in a controlled indoor environment. The site work was limited to a simple poured concrete foundation. Up until the time when the assembly and foundation were joined, everything happened at the scale of the hand. A forklift was needed only briefly to lift the structure upright to its full height.

Of the design/build projects, this one went the most smoothly in terms of scheduling. The scale and scope were manageable in one semester, and the limited number of people involved meant that communication and coordination were easy. While the experience was not as comprehensive as a full building project, the lessons of budget, materiality, and construction were certainly present.

FIG. 5 | Foundation detail showing how the shelter's column and tensile rod meet the ground.

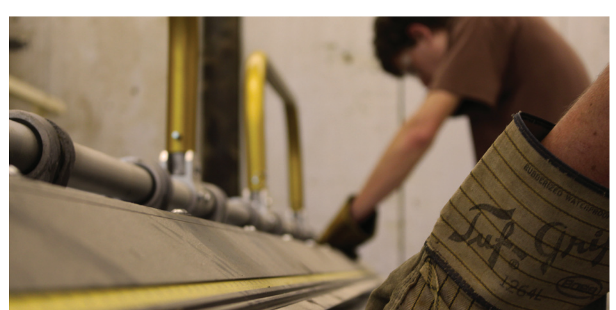


FIG. 6 | Students bend the shelter's roof segments on a large sheet metal break.

FIG. 7 | The completed cantilevering prototype. This section could be repeated several to form a modular bike shelter.

FIG. 8 | All of the study models produced during the train viewing platform's design and development phases.

TRAIN VIEWING PLATFORM

As a graduate student I worked as a teaching assistant for a design/build studio tasked with completing a train-viewing platform for the Glencoe Museum in the city of Radford, Virginia. The studio of eleven graduate students partnered with the College of Natural Resources to design a structure which utilized cross laminated timber as a primary material. The intended timeframe was one semester, though complications throughout the process made this impossible. As a contributor it felt as though my input in directing the studio was strongly considered due to prior experience with similar projects.

The design process was intentionally similar to the one used for the fields project. Individual students made proposals first and then paired off until three proposals were achieved. The primary difference, however, was the prescription of fifteen 5'x10' CLT panels which were required to be used as a primary material. Proposals were evaluated not only based on architectural merit, but also on utilization of the panels. Three schemes were presented representatives from the Glencoe Museum, and their feedback was used to distill the three into a final design.

For this project, construction documents were produced using Revit in an effort to streamline the process. Most students picked a role, and as with the previous projects, one person was in charge of organizing everyone's input. The design developed as we collaborated with several other colleges for help with the civil engineering, structural work, and construction sequencing. With this project, the professor took charge of handling the budget, coordination, and scheduling; thus, the dialogue was stronger between students and faculty than in either of the previous projects.

Unfortunately, due to a series of delays and redesigns, the build portion of the project was not realized before the end of the spring semester. The train-viewing platform is presently on hold for the summer and the construction portion of the project will be offered to students as an independent study in the fall.

CURRENT IDEOLOGY

THE PRESENT BODY OF SCHOLARLY WRITINGS ON DESIGN/BUILD PROJECTS IS A SOUP OF CASE-STUDIES AND ONE-OFFS IN WHICH EDUCATORS SIMPLY DESCRIBE THE METHOD THEY TRIED AND THEN EXPLAIN WHETHER OR NOT IT WORKED. MANY ARTICLES FOCUS IN ON A VERY SPECIFIC NICHE OR ARCHETYPE WITHOUT EVER ESTABLISHING A POSITION ON DESIGN/BUILD EDUCATION AS A WHOLE. THIS SECTION FOCUSES ON A SMALL GROUP OF WORKS WHICH INSTEAD TOUCH ON EITHER THE CORE PURPOSE OR KEY ASPECTS OF DESIGN/BUILD EDUCATION. FOLLOWING IS AN INTENTIONALLY BRIEF SUMMARY OF FIVE SEPARATE ARTICLES WHICH AIMS TO EXTRACT THE MOST IMPORTANT IDEAS FROM EACH.

INTERVIEW WITH BRIAN MACKAY-LYONS

FIG. 9 | Sheep barn construced by Brian MacKay-Lyons' Ghost Lab on his property in Nova Scotia.

In 2014, professors Keith and Marie Zawistowski interviewed prominent architect and educator Brian MacKay-Lyons for *Inform* magazine. The discussion was focused on the state of architectural education and the way the practice treats young architects. MacKay-Lyons is known for his daring design/build program called Ghost Lab which brought students and professionals together for a one-week design followed by a one-week build. The program was executed on his farm in Nova Scotia from 1994-2011, and has received international recognition.

In his interview MacKay-Lyons describes that initially Ghost Lab was a response to his dissatisfaction with both the academia and the practice. He expresses that "schools get flakier and flakier" and that "practice is becoming more and more dominated by a corporate globalized culture." Consequently, MacKay-Lyons believes that entry level architects are being treated as "mobile capital," and he states that "practices are not doing as good a job as they used to at the apprenticeship part of education" (Zawistowski 1).

This is a solid criticism of modern architectural education, and his response of creating a design/build program is a sound one. A program such as Ghost provides many of the lessons architecture students are losing to the "flakiness" of the academy and the globalization of the profession. MacKay-Lyons does, however, acknowledge that there were elements of his approach which were ultimately "insincere" (1) and "reckless" (3). He states that "an architect's role is not to be the builder… contractors are not happier if you start to act like a builder and start telling them where to pile the lumber or how to do things" (2).

While the primary goal of design/build programs should be to give architects a better understanding of the process of building, it is important to remember that builder and architect are different. Knowledge of building is necessary for an architect to do a responsible job, but the architect should not try to be the builder. Design/build projects should serve as an architect's exposure to building, not as a model for a sustainable mode of working. Most importantly, MacKay-Lyons shows that design/build programs can address the current shortcomings in both architectural practice and academia.

ARCHITECTURE LIVE PROJECTS

The book *architecture LIVE projects* is a collection of essays edited by Harriet Harriss and Lynnette Widder which argues the merit of “Live Projects” in architectural education. The two are both architectural educators at Oxford Brookes University and Columbia University respectively. Harriss is the director of a startup incubator for graduate architecture students called Live Lab, and Widder is a partner at the firm aardvarchitecture. The foreword of their book is written by Ruth Morrow, a Professor of Architecture at Queen’s University Belfast. She broadly defines Live Projects as those which “exist between the two tectonic plates of learning in academia and in practice” (Harriss, Widder xviii). As the collection of essays suggests, this does not always refer specifically to design/build projects, but to a range of works which exist between the pedagogy and the practice. The foreword of their book makes it clear, however, that the genesis of such projects is similar to the genesis of MacKay-Lyon’s Ghost Lab: “tutors create Live Projects, sometimes instinctively, in response to perceived gaps in education or areas of practice which formative design studios fail to address” (xix).

Though a response to the same stimulus, Harriss an Widder attach a different purpose to Live Projects. They argue that “Live Projects create channels for new, reciprocal influence from pedagogy to practice” (1). For them, the purpose of Live Projects is not necessarily about teaching lessons of building, but rather bridging the gap between the academy and the profession. The selection of essays the two include in their book reflects this, and the collection includes a plethora of students pretending to be professionals, and professionals pretending to be students. These case-studies are backed by a variety of essays explaining why blurring the line between pedagogy and practice is a good idea.

Harriss and Widder’s position contrasts sharply with MacKay-Lyon’s negative assessment of the academy and the profession. If neither the pedagogy nor the practice are in a good place, what good can come from bridging the two? The current corporate and globalized nature of the profession does not influence students positively, and a dose of architecture schools’ “flakiness” is the last thing architectural practice needs. Though their book contains several case-studies of design/build projects, it is important to understand that the purpose of design/build projects is not the bridging of pedagogy and practice which Harriss and Widder suggest. Instead it is the purpose of design/build projects is to bridge the gap between drawn page and the completed building by addressing questions which both the practice and pedagogy neglect.

LESSONS LEARNED FROM THE LIMITED DESIGN-BUILD EXERCISE

In his essay titled “Lessons Learned from the Limited Design-Build Exercise,” Professor James Middlebrook, an Assistant Professor of Art in Smith College’s Landscape program provides a more precise purpose for conducting design/build projects. He states “The crucial lessons of design/build are difficult to replicate through other educational means. Construction drawing classes may demonstrate materials and methods through readings and illustrations, but understanding the causal relationship between instigated design and resulting construction is best cemented by performing both acts; it is their relationship that allows the synergistic confluence of drawing and building” (Middlebrook 42). Middlebrook’s essay focuses specifically on the question of scale in design/build projects. He acknowledges that larger projects typically impart a more comprehensive experience, but he argues that smaller projects can provide many of the same lessons.

The seating area Middlebrook offers as a case-study is in fact a strong example of a design/build project. His discussion of scale, cost, liability, and construction all indicate an architectural experience beyond that of the typical studio environment. The project, however, is similar to the bike shelter prototype in that it is devoid of the critical lessons of community and collaboration in architecture. The seating area’s role as part of the larger Solar Decathlon house gives it some merit beyond the purely educational, but such projects are more akin to the studies conducted in architectural technology courses than built works of architecture. While Middlebrook’s study does not cover all lessons which can be expected of larger projects, his description of its success makes a convincing argument for the value of design/build projects at a smaller scale.

DEBATING THE MERITS OF DESIGN/BUILD

Typically, design/build projects are conducted in the studio environment. This is due to the amount of time, effort, and resources students are required to invest for a project to be successful. Chad Schwartz of Southern Illinois University Carbondale asks what would happen if a design/build exercise were to be conducted in an architectural technology course instead. In his 2015 paper titled “Debating the Merits of Design/build: Assessing Pedagogical Strategies in an Architectural Technology Course,” Schwartz outlines two design/build exercises conducted in his three credit hour technology course.

The first is a series of wall sections constructed by groups of students in a single day. This type of project is similar to Middlebrook’s seating area and the bike shelter prototype in terms of scope and scale. Its lack of design, user, and value beyond the educational, however, makes it even more akin to the material and assembly studies which are already a staple of architectural education. What makes the project worth discussing is the setting in which the wall sections were constructed. Schwartz states that construction happened in a lab immediately adjacent to the architecture building, and consequently “the wall section build activated the School of Architecture” (Schwartz 11).The entire school was charged by the activity and production happening in such close proximity.

The second project Schwartz discusses is a more conventional design/build situation. The technology course as a whole designed and constructed an amphitheater for the regional education center. Schwartz describes this endeavor as “detrimental to student learning outcomes” due to the amount of time necessary to complete the project. Additionally, the class size of sixty nine students makes it difficult to imagine that many of them provided anything valuable to the project beyond spare hands.

Both of Schwartz’s projects have weak points and strong ones. The wall sections can barely be considered a design/build project, but they speak to the power of such projects to activate the surrounding area. The amphitheater is undoubtably the more heroic of the two, but Schwartz’s criticisms of the project’s shortcomings make it difficult to call a success. This article is most valuable in its illustration that true design/build courses are best suited for a small class and the studio environment. Lack of resounding success with two different projects makes continuing an argument for design/build projects in technical courses unreasonable.

HOUSE DIVIDED: CHALLENGES TO DESIGN/BUILD FROM WITHIN

In 2011 Geoff Gjertson of the University of Louisiana at Lafayette conducted a survey of more than thirty design/build programs across the country and published his findings in a paper titled “House Divided: Challenges to Design/Build from Within.” The survey gathers some basic statistics, but also asks in-depth questions of the design and construction process for each program. The adjoining article focuses on the role of the faculty in the design/build process.

Gjertson argues that faculty for design/build projects are predisposed to a challenging experience due to “excessive workloads, multiple roles, and expanding student numbers and project scope” (Gjertson 25). His assessment is grim, but accurate. Due to the comprehensive nature of the programs they run, it is likely that design/build faculty take on far more responsibility than their academic counterparts. Gjertson provides a few suggestions to help mitigate this. He recommends that “at least three faculty members should participate” (28) in design/build programs. He also recommends that programs be cyclical allowing for faculty to take “off” years from design/build projects. While time off might not be the best solution, having multiple faculty members on a design/build project is essential. Though it may seem like a waste to have a studio of ten to fifteen students with two or three advisors, the additional input is absolutely necessary.

More interesting than Gjertson’s article are the results of the survey itself. For almost every open-ended question, the responses vary wildly. For the question “How much risk is taken in the decision-making by delegating to students?” responses range from “considerable” to “no risk” to “unknown” (30). Some participants offer more detailed explanations such as “obviously a great deal of risk is involved, but the learning outcomes are much richer and the results more significant” (31). Similar diversity exists in questions about the design process, the construction process, and dealing with failure.

This can mean one of two things. Firstly, a variety of responses can mean that there is a variety of what constitutes a successful design/build program. Some of the responses make it seem that almost anything can lead to positive “learning outcomes”… Alternatively, the variety of responses can simply mean that no one has really figured it out yet. In this case, lack of consensus on design/build best practices is concerning, and it suggests that there is either a lack of knowledge or a lack of communication of what it means to conduct a design/build course. This possibility is certainly the more frightening of the two, and consequently the purpose and execution of design/build projects warrants closer examination.

THE PURPOSE OF DESIGN/BUILD IN ARCHITECTURAL EDUCATION

ARCHITECTURE SCHOOL HAS DEVOLVED INTO A TEACHING OF DRAWING RATHER THAN A TEACHING OF BUILDING. IN HIS ESSAY “ARCHITECTURE” THE PROMINENT AUSTRIAN ARCHITECT AND EDUCATOR ADOLF LOOS EXPRESSES THAT THE ARCHITECTURAL PROFESSION HAS “REDUCED THE NOBLE ART OF BUILDING TO A GRAPHIC ART” (LOOS 76). MACKAY-LYONS MIMICS THIS SENTIMENT IN HIS INTERVIEW WITH KEITH AND MARIE ZAWISTOWSKI: “…UNIVERSITY CULTURE FORCES PEOPLE TO GET PHDS. SO THEY GET A PHD AND THEY ARE 45 YEARS OLD AND THEY HAVE NEVER SEEN A 2X4” (1). CATERING TO THIS MENTALITY, SCHOOLS ARE TEACHING THE PROCESS OF REPRESENTING, EXPRESSING, AND PRESENTING ARCHITECTURE RATHER THAN THE PROCESS OF MAKING IT. THE TYPICAL STUDIO REGIMEN OF RESPONDING TO HYPOTHETICAL PROJECTS CERTAINLY DEVELOPS DESIGN THINKING AND COMMUNICATION OF IDEAS, BUT IT FALLS SHORT OF EXAMINING SOME OF THE MOST CRITICAL LESSONS OF MAKING A BUILDING. DESIGN/BUILD COURSES SERVE AS THE PLACE FOR STUDENTS TO EXAMINE THE IMPORTANT ARCHITECTURAL QUESTIONS OF PROCESS, FEASIBILITY, COLLABORATION, AND COMMUNITY IN AN ACADEMIC ENVIRONMENT.

The typical architectural studio teaches effective means of representing architectural ideas. Making a work of architecture, however, involves the entire process of translating these representations into the built reality. The architect is the overseer of this process. Like the conductor of an orchestra, it is his job to direct all of the participants into a resonant manifestation of said represented ideas. To do this, he must possess a fundamental knowledge of each of the individual roles, but as Brian MacKay-Lyons points out in his interview, “[his role] is not to be the first violinist” (2). Managing this process effectively can mean the difference between a sound architectural idea being executed effectively or being lost entirely. Design/build projects serve as a means for students to navigate the entirety of building-making with knowledgable direction and supervision. As part of a design/build course students take on the responsibilities of coordinating, translating, and building their ideas, which are specifics usually neglected in the typical studio environment. Additionally, students’ firsthand exposure to the various architectural crafts provides a foundation of fundamental knowledge necessary for more effectively implementing their architectural ideas.

The discussion of feasibility in architectural education is rarely examined in the context of a studio project. Questions of budget and buildability are treated as subordinate to the overall design. In his writing about architectural philosophy, prominent architect Louis Kahn states, “a great building must begin with the unmeasurable, go through measurable means when it is being designed, and in the end must be unmeasurable. The design, the making of things, is a measurable act” (Kahn 69). In architecture school, the two “unmeasurable” conditions of initial idea and completed building are often the focus because they are considered more desirable and ideal. Instead, architecture schools should more closely embrace the specifics of the “measurable” in-between and bring the same idealism to questions of feasibility. While important steps can be made without the burden of a working budget, structural plan, and construction sequence, students should eventually be exposed to such constraints as preparation for both the difficulties and opportunities they can present. Design/build projects provide a modus for teaching the responsibilities and limitations which come with making a building. Students are exposed to everything from the cost of a particular type of wood to the finality of pouring concrete.

Architecture is by nature a collaborative endeavor. A strong building requires the input and expertise of engineers, consultants, and contractors. In the professional world, an architect’s relationship with these people is often one of friction or even resistance. While architecture school sometimes touches on collaboration with other fields, it is often experienced for the first time in a professional environment. This predisposes entry level architects to perpetuate the corporate mentality when dealing with professionals in other fields. During the train-viewing platform project, many of the graduate students who had spent time working in offices had a difficult time understanding the importance of having a conversation with the engineer rather than simply corresponding with him. A design/build project should serve as a place for students to learn how to leverage the knowledge of their peers in other fields without an overshadowing business mentality. Design/build courses are most successful in this when students from a variety of disciplines are all working together toward a common end. This way, the exchange

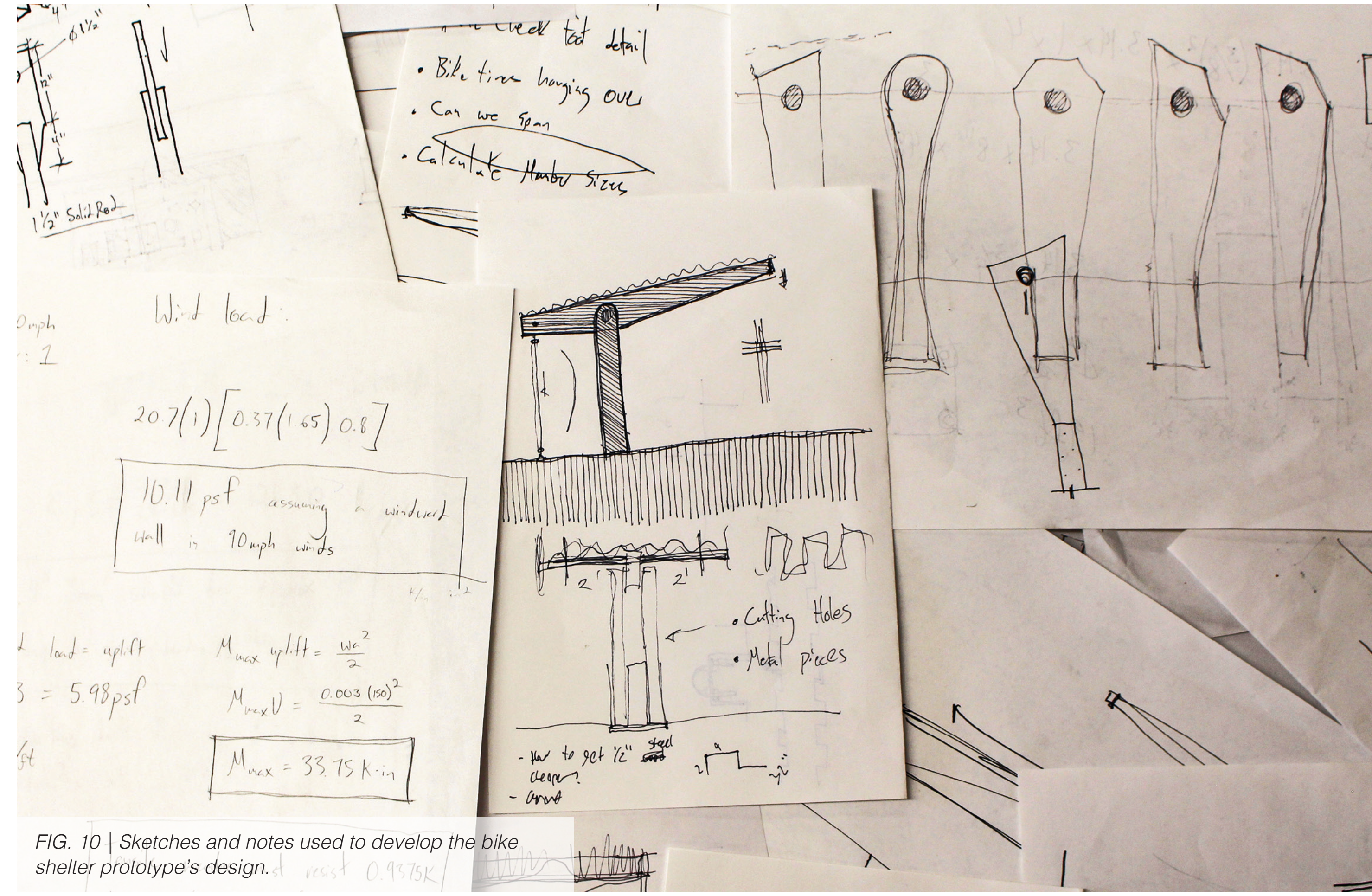


FIG. 10 | Sketches and notes used to develop the bike shelter prototype’s design.


FIG. 11 | Students from the design/buildLAB present their initial schemes to members of the Clifton Forge Little League.

FIG. 12 | Little League players and families experiencing the new fields and facilities for the first time.

of knowledge is a dialogue, and everyone gains an understanding of the value that each person and each field brings to the table.

Community is perhaps the most difficult facet of architecture to understand through the conventional studio practices. Every work of architecture has an end user. In a typical studio course, the relationship between architect and end user is purely a hypothetical one. Consequently, in the professional world the same relationship has been boiled down to a business agreement between “designer” and “client.” Neither situation is the ideal for producing the best architecture. Design/build projects allow students to experience architectural relationships which are neither hypothetical nor monetary in nature. They offer the unique experience for students to witness the actual interaction between their architectural idea and the people for whom they created it. Ultimately, one of the most impactful things to show an architecture student is the power a good design has to improve the lives of its users.

When a design/build project fails to engage architectural process, feasibility, collaboration, and community in a meaningful way, it becomes educationally irrelevant. The curriculum of architectural education is rapid and dense, and projects which do a mediocre job addressing these questions have no place in it. Some of the more potent criticism of design/build programs is made evident when a project has a major failure in one of these four areas. Critics state that design/build projects produce carpenters and welders, not architects. Similarly opponents often point out that students lose up to a year of design studio while wading through a mire of numbers and specifics. Furthermore, critics often express that large-scale design/build programs are not sustainable over a long period of time. When executed correctly, however, the opposite is actually true. The basic technical skills such as carpentry and welding which architecture students get to experience through a design/build project form a foundation of fundamentals which help them better translate architectural ideas into the built world. The direct engagement with all of a project’s details shows students the opportunity which lies in the specifics, and goes beyond the typical questions of studio design by teaching what is feasible and what is responsible. Finally, large-scale design/build programs are only unsustainable if they try to be autonomous. By forming connections through collaboration with other fields and the community, a strong network of support can be formed. A successful design/build program will address all four points thoroughly, but they should not be considered absolute. Design/build projects are a way show students what it means to be an architect, and how their designs can directly impact the world around them.

THE IDEAL DESIGN/BUILD PROJECT

IN THIS SECTION, EACH PIECE OF A TYPICAL DESIGN/BUILD PROJECT IS EXAMINED INDIVIDUALLY. AN OVERVIEW OF THE USUAL PRACTICES IS FOLLOWED BY CRITICISM, AND THEN A PROPOSAL IS MADE FOR THE BEST WAY TO HANDLE EACH PART OF THE PROCESS. AS A WHOLE, IT OUTLINES A METHOD FOR CONDUCTING A DESIGN/BUILD PROJECT WHICH SPEAKS TO THE PURPOSES DESCRIBED IN THE PREVIOUS SECTION.

PLACEMENT IN THE ARCHITECTURAL CURRICULUM

When examining the ideal scenario for a design/build program, the first thing to consider is where in the education of an architect such a project belongs. Auburn University's Rural Studio completes projects with second year students coming right out of foundation classes. At the opposite end of the spectrum Yale's design/build program works almost exclusively with graduate students. The success of both programs shows that design/build projects can be completed at any point in an architect's education, but there is an argument to be made for more precise placement of design/build courses.

As a third year working on the fields project, all of the lessons felt valuable. There were, however, times when information presented in the concurrent technical courses would have been invaluable to possess at the beginning of the studio. Working with graduate students on the train-viewing platform the discussion of specifics such as budget and construction documents felt redundant for students who had already spent several years working in the office. While many of them desperately needed the lessons of building, collaboration, and community, it was difficult for them to accept a method of working which conflicted with their experiences in the office. Because of their lack of interest in details they thought they already knew, they missed the more important lessons of how to more responsibly function as an architect in society.

For these reasons, a design/build course should ideally be placed as early as possible in an architect's education. This ensures that students understand comprehensively what it means to be an architect and what it means to make a building before entering a professional environment. Importantly, however, this placement must also be balanced by the responsibility that comes with putting a building into the world. Before working with real people and real materials, students should be exposed to as broad a range of design thinking and technical methods as possible. Consequently, the fourth year of architectural education is the ideal point for a student to participate in a design/build project. This allows them to leverage the full effect of previous studio and technical courses while still providing the range of lessons on building, feasibility, collaboration, and community.

SCOPE AND TIMEFRAME

Next it is important to identify the ideal scope and timeframe of a design/build project. Scope ranges from the wall sections done by groups of five at Southern Illinois University Carbondale to the community-wide projects completed by the Rural Studio. Similarly, timeframe ranges from the two-week structures completed by Brian MacKay-Lyons' Ghost Laboratory to the year-long projects done by the design/buildLAB. For the bike shelter prototype the scope was simply too small. The experience was more akin to material studies conducted in architectural technical courses than to actual building. It did provide ample opportunity to examine questions of structure and detail, but it did not facilitate anything more than a topical examination of making architecture. At the other end of the spectrum, the fields project encompassed too large a scope. A significant portion of time on the project was lost to having components which needed to be repeated multiple times, and individual students burned weeks learning the specifics of plumbing, wiring, and field maintenance. When too much time is spent on such details, it detracts from the overall lessons of making architecture.

Scope and timeframe are perhaps the most important factors to get right to have successful project. In general, the larger the scope, the more complete the experience it has to offer. It starts to break down, however, when the project becomes too large for the number of students working on it, or when the timeframe becomes too prolonged to keep focused. This means that the proper scope of a design/build project should be determined by a combination of the number of students participating and the project's timeframe. Both the fields project and the train-viewing platform suggest that ten to fifteen students is the upper limit for a group where everyone can participate meaningfully. Building on this, two semesters is likely the upper limit for keeping ten to fifteen students together academically. Therefore, the scope of an ideal design/build project is the largest possible project which a studio of ten to fifteen students can comfortably complete in a single academic year. Operating at such a scale would afford every student the time necessary to understand the complete process of making a work of architecture.

PROGRAM, FUNDING, AND CLIENT

Scope and timeframe are not the only factors to consider when choosing a design/build project. The architectural program, the location, the funding and the end user should also be examined carefully. According to the survey conducted by Geoff Gjertson (28), programs for design/build projects range dramatically from wall sections to community centers to single family homes. Each of these has its merits, and often need is the determining factor.

Similarly, project location is not always something which can be chosen freely. For the bike shelter prototype, working entirely on-campus was a wonderful luxury, while the ninety minute drive to Clifton Forge for the fields project is likely the limit of what is sustainable. The effect of distance from the site can be mitigated by implementing construction techniques such as prefabrication and modularity, but the importance of proximity is not to be neglected.

Unfortunately, it is impossible to discuss design/build projects without addressing the questions of funding and client. Regarding architecture as a business or an industry is generally a hinderance to the student experience, but ultimately these are undeniable parts of making a building. Gjertson's survey indicates that the funding for design/build projects can come from a variety of sources including the institution, the client, grants, fundraising, and charitable organizations (30). In the case of the bike shelter prototype the funding came primarily from a research grant. This meant that there were many instances where the design of the project was warped to suit the intended research more closely. Additionally, this led to scenarios where students were paying for significant portions of the material out-of-pocket with the promise of later reimbursement. In the case of the fields project and the train-viewing platform, the Clifton Forge Little League and the Glencoe Museum funded the projects directly. More specifically, the fields project funding was a combination of money from the Little League and a grant for building baseball parks, and the train viewing platform's funding was a combination of money from the Glencoe Museum, the School of Architecture + Design, and a crowdfunding page. This resulted in a more typical client/architect relationship where the client is offered services they would be otherwise be unable to afford in exchange for working with students.

While all of these things are necessary for a successful design/build project, it is important to remember that the end user should be an architect's primary concern. In the case of the bike shelter prototype, the end user was only hypothetical. In terms of serving the lesson of end user, the project was no better than the typical studio project. At the opposite end of the spectrum, the design/buildLAB was extremely attuned to the community it was serving. Whenever help was needed, members of the community would volunteer services, equipment, and hands. Both the designers and the users understood the importance of the project and were consequently able to achieve a result which would have otherwise been impossible. At the end of the project, watching the Little Leaguers and their families enjoy the fields for the first time perfectly illustrated the uplifting power of architecture, and revealed the ultimate joy of being an architect.

In the ideal design/build scenario, a program should be chosen which benefits the surrounding community at large. The project should be public in nature, and intended to be a permanent work of architecture. The primary shortcoming of the bike shelter prototype was that its purpose was purely academic. When investing significantly into real materials and resources, it is architecturally irresponsible if the physical product does not have a purpose larger than its educational face value.

The ideal site for such a project is the one which best facilitates proximity to the construction. This allows for students to directly engage with their immediate community and have ready access to both the place and the end users throughout the process.

To facilitate this relationship, funding would ideally come from a partnership between the client and the academic institution. This would mean that the institution is taking some responsibility for the work of its students, but the bulk of the money is still coming from the client. It is important for architecture students to understand and accept the risks which come with being trusted to work with other people's money.

Finally, the ideal client for a design/build project is one who is accepting of the fact that they are working with students. Openness to design possibilities should be a requisite, with the understanding that in exchange they will receive a thoughtful work of architecture. Most importantly, students should be exposed to the way the end users of their project interact with the architecture. All doubt of a project's merit can be dispelled by feedback from the people who will use it daily. It is absolutely paramount that students get to see and understand the positive impact their work as architects can have on a community and the world, as ultimately, this is the purpose of architecture.

STUDENT EXPECTATIONS

The level of student involvement varies from program to program. In some design/build programs, architecture students are engaged in every part of the process from the primary design work all the way down to the details of plumbing and electrical. In some projects, students

FIG. 13 | Students reviewing schemes for the train viewing platform with their advisor.

FIG. 14 | "students will be expected to put in far more effort and time than what is required of a typical studio class..."

do all of the design work, and then building is delegated to fabricators and professionals. In other projects, students are omitted from the design process, but serve as the primary builders (Gjertson, 31). Each mode speaks to what the program is trying to teach its students about the process of making a building. Additionally, at some schools, participating in a design/build project is a requirement, where at other schools it is a choice. Though all of these factors create vastly different student dynamics, detailed examination of the student experience is scarce.

Firstly, students should have a choice as to whether or not they want to participate in a design/build project. Additionally, it is important for the students in a design/build program to understand that it is a privilege to put architecture into the world. This means that students will be expected to put in far more time and effort than what is required of a typical studio class. It should be understood that students will be volunteering their time over and over again to both the project and the community. There should be no guarantee of of a completed work of architecture. Completion of the project should be entirely the responsibility of the students, and consequently, there should be no quarrel with cutting students who are slacking or creating a negative atmosphere. While such students may still be receiving the intended lessons, the morale of the studio as a whole is vastly more important.

It is imperative that a design/build team starts working together as quickly as possible and then continues function as a team through all of the highs and lows their project presents. For both the fields project and the train-viewing platform, such a sense of unity was not established until after the design process. The social dynamic of both studios resulted in valuable ideas being discarded or going completely unsaid. To avoid this, a design/build studio should participate in rigorous team building exercises starting on the first day of class. The important part is to get the group working effectively and comfortably together as quickly as possible. Perhaps the most productive task toward this end would be the maintenance of previous projects. This would not only get everyone working together, but also introduce students both to building and community.

Finally, in an ideal design/build project, the student's role should be a complete one. In his interview, MacKay-Lyons states that "[the architect's role] is not to be the first violinist" (2). This goes hand in hand with the idea that not every student needs to "swing the hammer." If given the choice, however, every student should have the opportunity to do so. If the choice of participating in a design/build project is offered to students, then the experience of learning to make a building should be as complete as possible. Students should be responsible for everything from initial design to the final construction, and should be the ones conducting and managing all of the steps in between.

FACULTY EXPECTATIONS

In his article Gjertson thoroughly discusses the role of a teacher in design/build programs. His assessment that the position is a demanding one is accurate, and there are several contributing factors. Firstly, according to both Gjertson and his survey, design/build faculty have a host of responsibilities beyond those of the typical teacher. Often they also serve as advising architect, technical resource, organizer, client contact, drawing stamper, morale counselor, and friend. Additionally, their responsibilities extend both before the students arrive and after the students leave. Sometimes the faculty member is responsible for finding both the client and the funding before the project begins. After the project ends, the faculty typically remains the point of contact for the client and the party responsible for documentation and publication (23-28).

For the Little League fields project, two professors shared these responsibilities. They were both experienced and knowledgable, and understood exactly what needed to be done to make the project happen. The days they were present, the project surged forward, but often, especially during construction, it felt as though they were elsewhere at critical times. Even as a team the two felt stretched too thin between their other responsibilities and the project. The bike shelter prototype was also managed by two professors. One was utterly unhelpful, uninterested, and absorbed entirely in his own publishing and research. He made publication the driving force of the design and made no effort to assist or contribute other than funding it. Fortunately, the other professor involved provided the vital chunk of knowledge, feedback, morale support, and manpower necessary to complete the project. For the train-viewing platform, the professor took on many of the tasks delegated to students in other projects. The budgeting, materials acquisition, scheduling, and coordination were all handled away from the eyes of the students. While this shifts the focus of the design and development process toward questions of architecture, it masks a significant portion of what it means to build. It frequently felt as if the professor was taking on too much, while some of the students were still left empty-handed.

Ultimately, it is the people involved that can make the difference between a successful and an unsuccessful design/build project. Having a receptive client and motivated students is important, but it is the faculty that can make the strongest impact on the outcome of a project. The responsibilities of design/build faculty are vastly more rigorous than the typical design professor. For a successful project, the advising faculty needs to be comfortable with delegating everything, knowledgable enough to explain anything, capable enough to fill any role, and energetic enough to always keep the project moving forward. It is important for the faculty to delegate as many of the project's tasks as possible to their students. Ceding responsibilities ensures that students experience the process in as complete a manner as possible. It eases the tasks of the professors, and keeps students motivated. At any time, however, the faculty needs to be able to answer any question about any part of the process. They must be able to teach everything involved with making a building including design, presentation, logistics, specifics, and construction. Whenever a student needs guidance, the faculty should be both able and available to steer them in the correct direction. In the studio, the advisor should serve as organizer, critic, resource, and mediator. On the job site they should function as construction manager while simultaneously working alongside their students. The advisor should always be able to answer the question "what next?" It is their responsibility to keep the project moving smoothly, and ensure that everyone involved is working as effectively as possible. Above all, the advisor should function as a leader, and manage the entire process of making a building with students with skill and specificity. For the ideal design/build studio of ten to fifteen students, one advisor is not enough. Though not impossible, a solitary professor would need to be utterly dedicated to the project. It is more likely that these responsibilities are better shared between several faculty. Having either two or three advisors would allow for them to specialize in particular parts of the process. Additionally, the authority and guidance of faculty could then be present in multiple places at the same time. Overall, advisors should support their students relentlessly with the primary goal of teaching the process of building and completing a work of architecture.

DESIGN PROCESS

The process of arriving at an agreeable and buildable design with a group the size of a studio is always a challenge. It must not only answer the questions of the program elegantly and responsibly, but also allow everyone involved to contribute in a meaningful way. Some design/build projects such as Schwartz's wall section project at the Southern Illinois University Carbondale avoid this altogether by having no design at all. According to Gjertson's survey, another common method of avoiding the design process is to build a design done by the faculty (29). While these methods quickly and effectively bypass the challenges of the design process, they simply defeat the purpose of a design/build project. Removing the design from the hands of architecture students undermines the most vital part of the process. Gjertson's survey offers several other methods for student design. Most commonly either the students or the faculty vote to determine the best project. Similarly, an impartial jury is sometimes used to choose a design (30). The flaw with these methods is that important and thoughtful parts of the projects, which are not chosen, are often forgotten. The last method Gjertson's survey suggests is one of discussion and consensus. This is strong because it encourages important discussions of architecture, but it can lead to situations where the most vocal participants are the only ones driving the design.

As previously discussed, both the fields project and the train-viewing platform used a similar design process of iteration and merging. The ideal method of arriving at a final scheme for a design/build project is likely something similar. Each student should begin with an individual proposal. The initial designs should be focused on broad ideas about the site and the program. After students present these initial thoughts, faculty should then pair students based on affinity between ideas. It is at this point that the faculty can influence which ideas are worthy of being carried forward, and which ideas are unimportant or not feasible. Additionally, it is important that the faculty choose the pairing of students to ensure that the match is based on commonality of thinking and not the comfort or familiarity of the students with each other. This helps get the studio working together quickly and effectively. Once pairs are established, they should be instructed to discard all but the strongest ideas and propose a new design together. The new proposal should be more detailed than the first, and incorporate the strongest ideas which the two initially had in common. Above all, it is important that the new design not be an an amalgam of the previous two. Simply stapling similar ideas together results in crummy and effortless proposals. After presenting the new schemes, the process is then repeated until students are merged into either two or three schemes. Once these are presented, this is the ideal time to receive feedback from sources

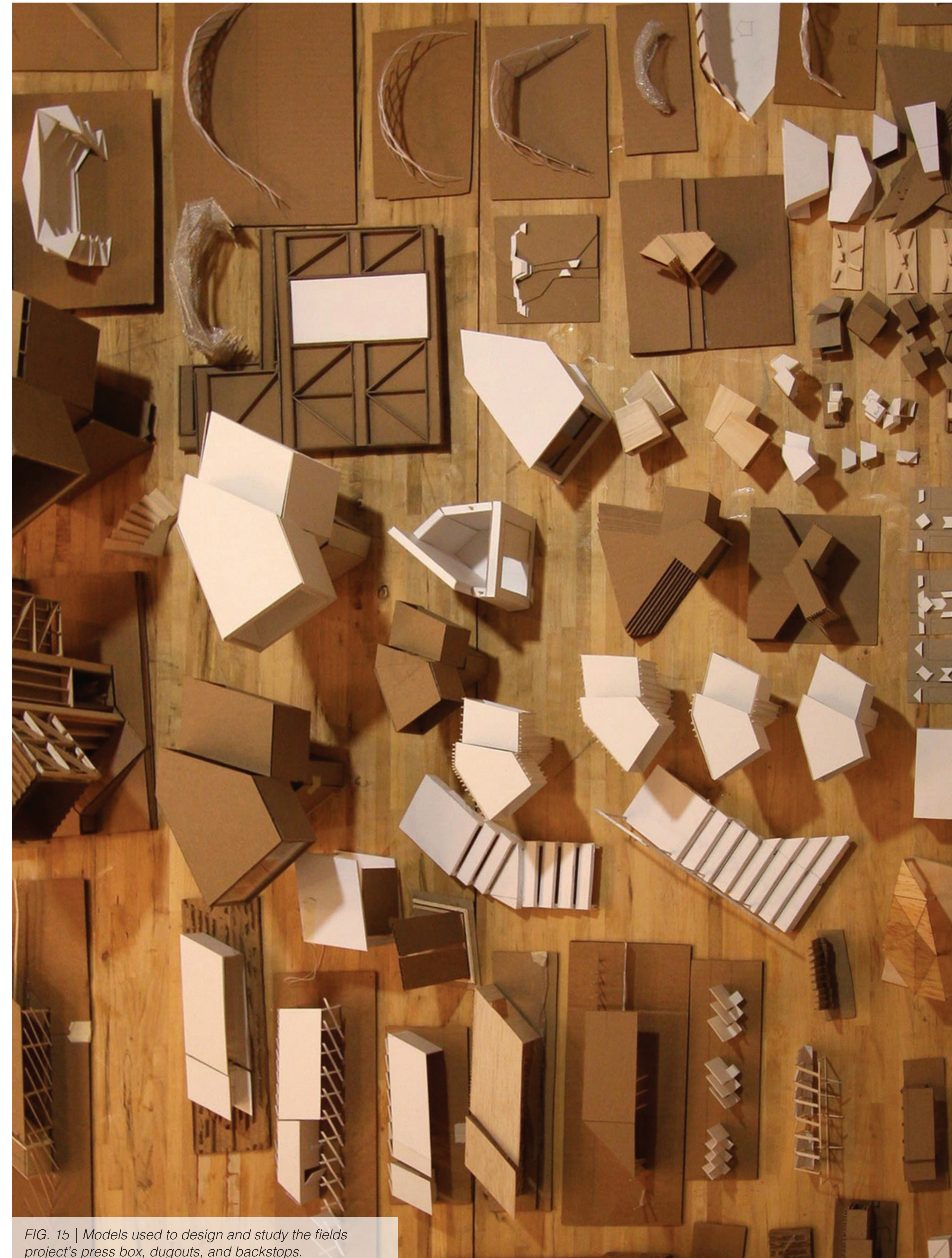


FIG. 15 | Models used to design and study the fields project's press box, dugouts, and backstops.

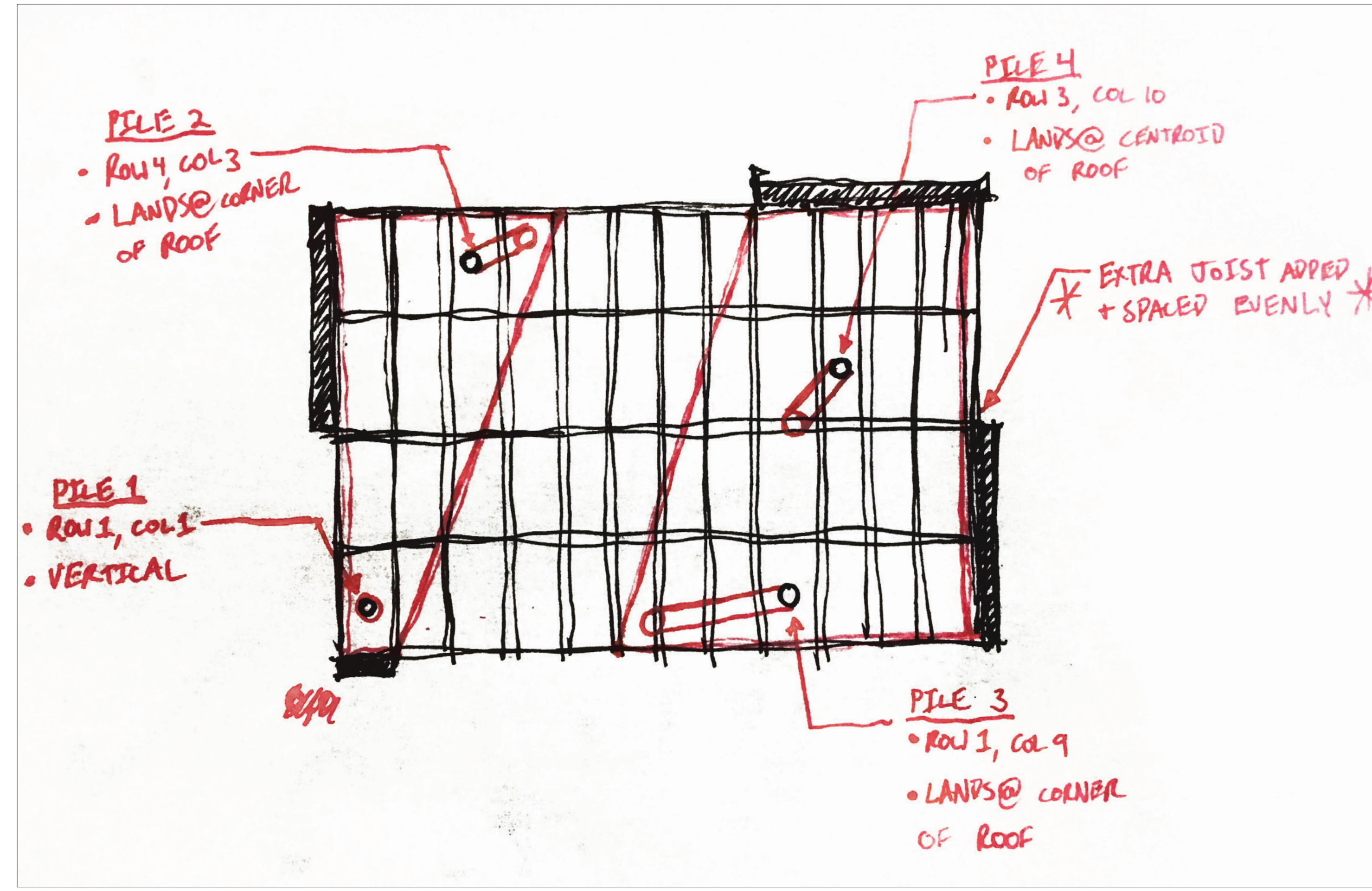
outside the studio.

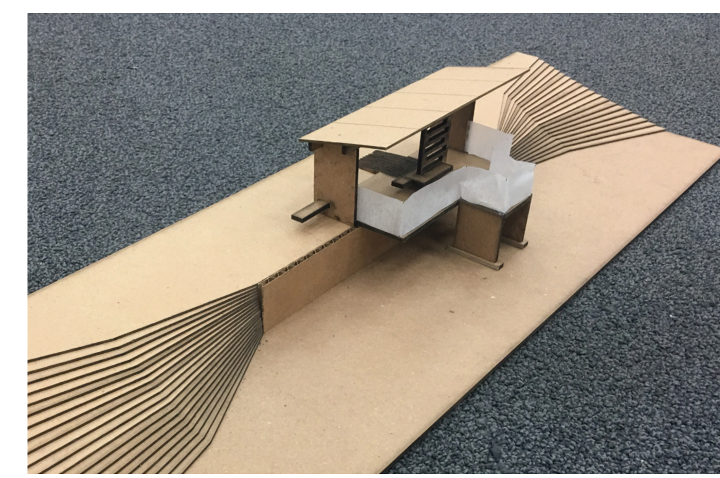
The same presentation of two or three schemes should then be made to clients, consultants, faculty critics, and professionals. This ensures that when the final merging into one scheme happens, there is a clear understanding of what is good, what is strong, and what could be improved. The final merging of schemes should be done collaboratively as a studio with the faculty participating as mediator. As before, all of the prior schemes should be discarded, and only the very strongest parts of each should be brought forward. At this stage it is tempting to take votes or pick and choose pieces, but it leads to an architecture of stitched-together parts which should be avoided at all costs. The process will likely take several days of discussion, and many hours of iteration. Whenever a question of form or utility becomes too tiresome, students should all take a few hours to work individually on study models or drawings. These studies should all be conducted at the same scale, and then comparisons can be made directly as a group. Once the design is agreed upon, the studio should collectively create the presentation materials necessary to convey the final scheme. This ensures that everyone understands the design, and is on the same page moving forward. The design process should be concluded with an exhibition of all iterations, models, schemes, studies, and drawings which led to the final scheme displayed together.

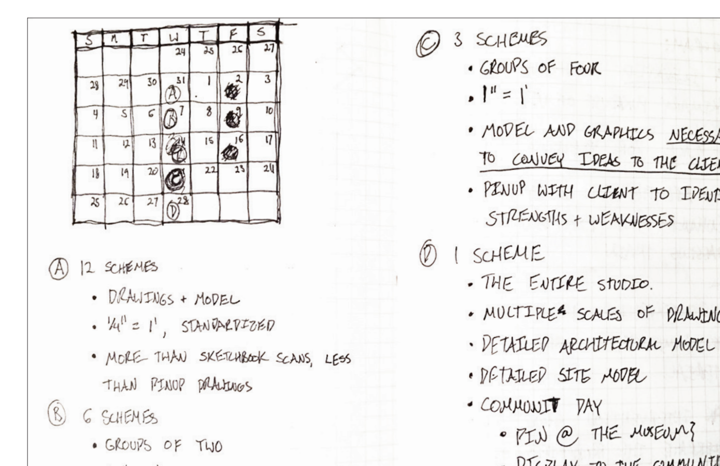
DEVELOPMENT PROCESS

In between the initial design and the construction of a design/build project, there is a place where students need to learn to get specific. For the fields project, individual parts of the development process were delegated to individual students. One person was in charge of managing the budget, one person was in charge of plumbing, one person was in charge of lighting, and so on. While this is an effective method of ensuring that everything is accounted for, this is where Brian MacKay-Lyons' "first violin" principle comes into effect (2). Design/build projects are about educating architects, not electricians or truck drivers. While a knowledge of electrical work or construction machinery undoubtably augments one's abilities as an architect, there is a point where other important lessons become lost. For the bike shelter prototype, the development process was driven by a push to research and publish. While the students handled the questions of structure, detail, and budget autonomously, refinements to the project were consistently pushed to align with ongoing research. Sometimes scholarly research and design/build projects go hand in hand, but this is not always the case. The primary purpose of a design/build project should be to teach young architects the art of building, and any research which gets in the way of this should be nixed in favor of a strong project. For the train-viewing platform, much of the development process was undertaken by the professor. Consequently, it felt as though students had less control over the important parameters of the project. Changes to the budget, materials, and structure felt like they came out of nowhere, and such alterations often seemed arbitrary.

Up until a final design is decided, design/build studios are very similar to the typical studio experience. Afterward, however, begins the teaching of how said design is brought into the world. This includes lessons on budget, structure, materials, systems, building code,







CLOCKWISE: FIG. 16, 17, 18, 19 | Notes, sketches, and models made to develop the train viewing platform's design.

FIG. 20 | A student from the design/buildLAB meets with engineers to discuss earthworks and site grading.

and construction documents. Often these lessons are first experienced working in an office, and thus are approached in a corporate manner rather than an architectural one. Students should be exposed to the idea that each of these specifics has the power to improve the design rather than limit it. Though intimidating at first, students should have ownership over every part of the development process. If the client or the advisor or the consultant simply dictates the way the budget falls, or the way the structure needs to work, it becomes a limit. If the students can take charge of of those things, and are instead encouraged to manipulate the budget or study the way the structure works, it becomes an opportunity. A search for a more economical material can lead to a beautiful discovery about light; a thorough examination of structure can create spaces which could never have been conceived otherwise. One of the most important parts of this is collaboration with other fields. Professionally these interactions are often ones of friction, but design/build projects offer a unique opportunity for students to learn the challenges of the people they will work with while making a building. Ultimately, this makes for architects who are more understanding and considerate of the people who make the construction of their designs possible. To facilitate this collaboration, a design/build studio should draw on the resources of its academic institution as well as the surrounding community. Collaboration creates both excitement and support, and can unlock a wealth of knowledge and resources which would be otherwise unavailable. Overall, the purpose of the development process is to teach students how to effectively translate their designs into something which is buildable. Although running the gauntlet of specifics can be tedious, it is possible to navigate while improving the project as a whole.

CONSTRUCTION PROCESS

The actual act of building is perhaps the most diverse piece of design/build projects. For MacKay-Lyons and Ghost Lab, all of the building is completed in the span of a week. Students, architects, and craftsmen all work together on the site (3). The intermingling of professions during construction lets architects and students learn directly from expert builders and facilitates the project's rapid timeframe The amphitheater project completed at Southern Illinois University Carbondale involved students constructing the entirety of the project on site. As Schwartz points out, "inability to continually monitor the entire group of inexperienced students led to disappearing students, standing around, and a general loss of productivity" (7). The wall sections built under the same professor at Southern Illinois University Carbondale are constructed publicly on the university campus. Faculty and students work together, and the setting "activate[s] the School of Architecture," encouraging collaboration by students of all years (11). For the fields project, most of the structures were prefabricated at Virginia Tech. Similarly, the bike shelter prototype was constructed primarily in the controlled environment of the college's shop. Prefabrication allows students to learn the basics of construction in a controlled environment, and expedites the building process. Rather than being prefabricated by students, the majority of the train-viewing platform is scheduled to be assembled remotely by a fabricator and then transported to the site. While this method of construction is certainly expeditious, it teaches lessons of collaborating with contractors rather than lessons of making buildings, and such lessons are already available in the office.

Construction is the portion of a design/build project where students can most directly experience the translation of the drawn page into the built reality. Consequently, it is important that students take as active a role as possible in the building process. To facilitate this, the ideal design/build program should have multiple knowledgable professionals present through the entirety of the construction process to function as advisors and to keep the project moving. It is these people who can best explain how drawings are translated into buildings. It is important to remember that when it comes to construction, students are not trained professionals. Strategies should therefore be implemented to mitigate construction time. Prefabrication is often the most effective strategy. Working in a controlled environment provides students a comfortable place to learn the ropes and vastly increases production time. Modularity is another strong option. Having repeated structures or elements which can be constructed in an assembly-line fashion can also drastically compress a construction schedule. The choice of construction method should be informed by the project's design, but once established, the project's design should start to be informed by its construction method. This is critical because while working in a controlled environment and repetition of elements can be a project's biggest time saves, getting mired in tedious details is often where most of a project's time is lost. Finally, the construction process should strive to engage the community as much as possible. As Schwartz points out in his article, the proximity of his wall section project to the architecture school created a dialogue between the two for the day. Proximity to the academic environment is the easiest way to replicate this. If a design/build studio constructs its project nearby, both studios and technical courses alike can use the structures and methods as a direct reference. Additionally, it is important to foster this kind of engagement with the receiving community. With the design/buildLAB, there was a day where community volunteers were encouraged to come and help with simple tasks such as painting and landscaping. Bringing the end user into the construction process allows them to take ownership for the project, creates a sense of excitement, and provides reliable sets of extra hands when they are needed most.

DOCUMENTATION

After a design/build project has concluded, there is a process of documentation and display in which the project is presented to both its users and the world. For the fields project, documentation was conducted by a professional architectural photographer on the opening day of the Little League. The project was then submitted to various publications and nominated for several awards. The bike shelter prototype was documented by the participants and the drawings, sketches, models and photographs were complied into a book. The project was also displayed at an annual event at the school's research facility. In both cases only one or two of the participants played an active role in the documentation process, and for the most part it was the responsibility of a few students to put the project on display. In conclusion, each student received a copy of all of the project's documentation and was given credit in publications.

FIG. 21 | All of the bike shelter prototype's wooden members. Each of the project's parts was designed to be fabricated separately before being transported to the site.

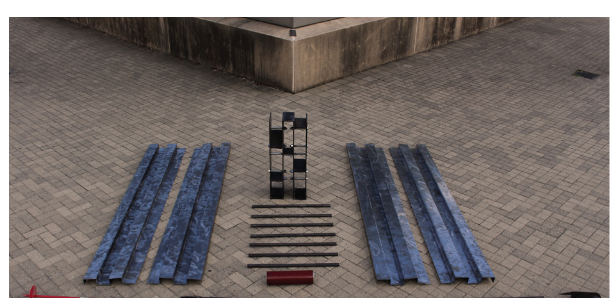


FIG. 22 | All of the bike shelter prototype's steel members. After fabrication, the wood and metal parts were assembled together on site.

In the ideal design/build program, documentation and publication of the project would be participatory for all of the students involved. This allows students to experience a part of the architectural process rarely acknowledged in school. The project should be photographed by a professional and submitted for a range of publications and awards. It is only at this point that relevant research should be considered and compiled into its own document to be submitted separately for publication. Here it is important to draw on the resources of the academic institution for both publicity and networking. The institution should support and advertise the work of its students, and the resulting exposure can lead to connections for collaboration in the future. Each student and faculty member should be given access to all of the project's documentation including photographs, drawings, and presentation materials. Finally, each student and faculty member should be credited individually by name wherever the project is published.

FIG. 23 | The fields project in its context beside the previous design/buildLAB's fieldhouse pavilion.

CONCLUSION

IN HIS ARTICLE DISCUSSING SCALE IN DESIGN/BUILD PROJECTS, MIDDLEBROOK STATES, “ARCHITECTURAL EDUCATION IS PRIMARILY INTENDED TO PREPARE ITS STUDENTS FOR PROFESSIONAL CAREERS OF BUILDING DESIGN IN MARKET CONDITIONS” (42). HARRISS AND WIDDER TAKE A SIMILAR POSITION WITH THEIR CONSIDERATION OF “PEDAGOGY INTO PRACTICE… OR PRACTICE INTO PEDAGOGY?” (1). THE IDEA THAT ARCHITECTURE SCHOOL IS MEANT TO PREPARE STUDENTS FOR THE PROFESSIONAL ENVIRONMENT IS ILL-FOUNDED. MACKAY LYONS WRITES THAT PRESENTLY “LARGE CORPORATE PRACTICE VIEWS YOUNG PEOPLE AS MOBILE CAPITAL, HUMAN CAPITAL” (1). PREPARING YOUNG ARCHITECTS FOR A WORLD WHERE THEY ARE RELEGATED TO A COMPUTER PRODUCING CONSTRUCTION DOCUMENTS AND PERPETUATING THE CORPORATIZED RELATIONSHIPS BETWEEN ARCHITECTS, CLIENTS, AND COLLABORATORS IS A GRIM OUTLOOK. INSTEAD, IT SHOULD BE THE PRIMARY PURPOSE OF ARCHITECTURAL EDUCATION TO PRODUCE RESPONSIBLE AND KNOWLEDGABLE ARCHITECTS. THIS APPROACH HAS THE POTENTIAL TO CHANGE THE PROFESSIONAL NATURE OF ARCHITECTURE IN ITS ENTIRETY.

FIG. 24| The community of Clifton Forge and the architecture of the design/buildLAB coming together for the Little League's first game on their new fields.

Design/build projects provide a unique opportunity to show students the power their designs have to improve the world around them. This shows students their potential beyond the entry level corporate position of mindless "CAD monkey." There are fundamental flaws in the way the world practices architecture, and design/build projects are a method of humanizing it again. Clients, consultants, and collaborators are all people with a wealth of knowledge to contribute to the design process. Using design/build projects is the best way to equip students with an understanding of how to work with these people while simultaneously providing the basis of technical knowledge necessary to effectively translate their architectural ideas into the built reality.

Architecture is a field where the technology is evolving on a daily basis. Digital tools for design, new means of fabrication, and advancements in building materials mean that architects must operate in an environment which is constantly evolving. Consequently, it is tempting for design/build projects to indulge in these technological advancements as a means of generating research opportunities or grant funding. Unfortunately, this tends to warp the project's focus away from what is important: the process of making architecture. While it is not impossible for cutting edge technology and digital fabrication to be incorporated successfully into a design/build project, it should never be the primary focus. At their core, all design/build programs should teach the fundamental underlying principles of architecture which exist regardless of the means used to produce them. Then, students should be exposed to a full range of materials and production techniques and be allowed to select for themselves which are important. This approach ensures that design/build projects are not simply an exhibition of the materials or techniques that are trendy at the time. Additionally, when working with students, the experimental materials and means of fabrication are often the riskiest in terms of a project's longevity. Consequently, such methods should only be explored if they are seriously integral to a project's identity.

As a whole, architectural educators need to stop attempting case-study after case-study for the purpose of cataloguing and publication. The previously outlined purposes for which design/build projects should be conducted are vitally important. As critics indicate, poorly executed design/build projects can ultimately be harmful to he education of an architect. Therefore, design/build projects need to be approached in a more methodical and sustainable way. To do this, educators must understand that the primary role of design/build projects is to teach the process of making architecture in its entirety.

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